ANALOG

SCIENCE FICTION AND FACT

DECEMBER 1992

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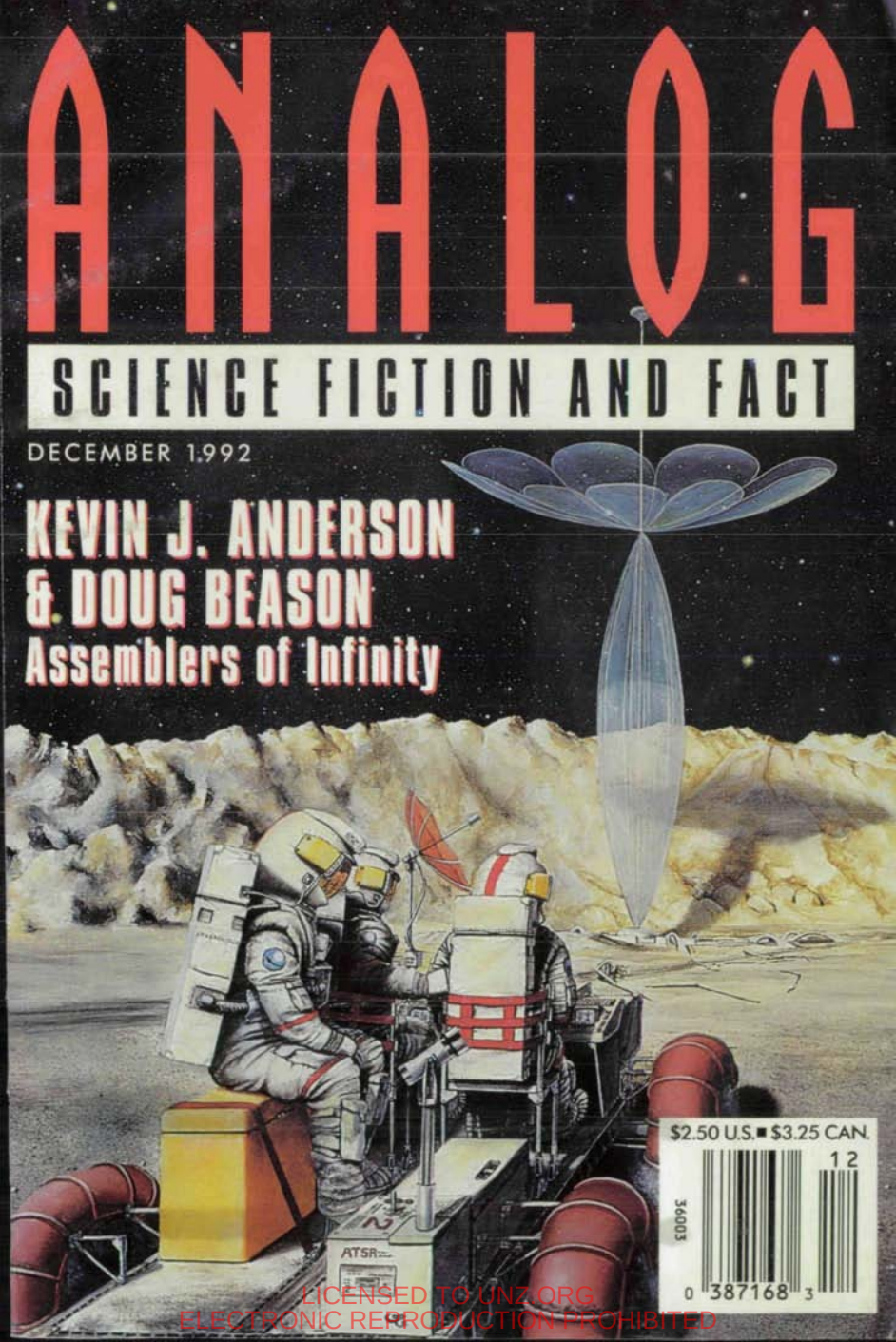

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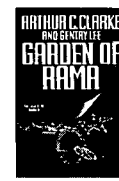

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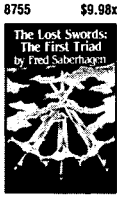

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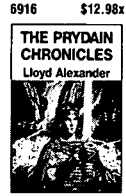

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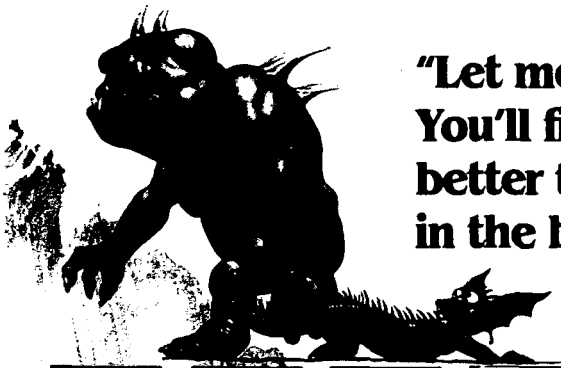

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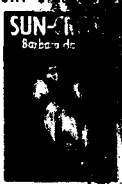

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December 1992

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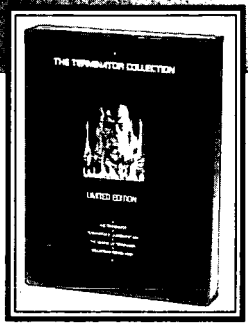

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EDITORIAL Stanley Schmidt

EUMEMICS

Shortly after arriving at the World Science Fiction Convention in the Netherlands in 1990, I heard somebody point out a subtle but highly significant effect of recent improvements in transportation and communication. (My apologies to whoever it was for not giving more specific credit, but I had just come off a trans-Atlantic flight and things were still a bit of a blur. . . .) The point was this. Now that people are no longer effectively confined to a small geographic area, and therefore can interact easily with many more people, they often feel closer to those with whom they share interests and beliefs than to their blood relatives.

Or, as the speaker put it, they feel more closely related to those with whom they share memes than to those with whom they share genes.

In case you haven't encountered it before, or to refresh your memory, the word "meme" was coined by Richard Dawkins in 1976 as a deliberate analog of "gene." It can be defined as a replicating information pattern that uses minds to make copies of itself, much as a virus uses cells to make copies of itself. (H. Keith Henson discussed the concept at length in his August 1987 *Analog* article "Memetics and the Modular Mind," later reprinted in the book *Analog Essays on Science*, published by John Wiley & Sons, Inc., in 1990.)

Both genes and memes are essentially pure information. Genes are packets of information about how to build an organism. Memes are information about other things, such as the idea that Hula Hoops are fun to play with or that memes are a useful way to describe the dissemination of ideas.

Memes are not necessarily "good" or "bad." Historical examples have included the idea that widespread education is generally beneficial to society (which most of us would approve) and the idea that one race is superior to another and should exterminate it (which most of us wouldn't). What makes an idea a meme is its tendency to spread from one mind to another—and sometimes to mutate in the process.

As such, memes provide the mechanism for a second kind of inheritance and a second kind of evolution. The drive to reproduce is in essence a drive to pass on to posterity the genetic information an individual carries. From the individual's point of view, this is a way

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to obtain a sort of immortality, by preserving some of the information that define his or her identity in a way that will outlive his or her physical body.

But who you are is not just the genes that told your body how to build itself. It's also the whole complex of *ideas* that you've acquired since birth. If you can pass those on to others who follow you, that's another way of gaining "informational immortality." Most people try to transmit both genetic and memetic legacies, to at least some extent: having children is genetic, raising them is memetic.

Most people, of course, concentrate more of their effort on the genetic. It's easier and surer. Practically anybody can pass on a genetic inheritance with a high probability of its surviving far into the future, and it doesn't take much conscious effort. It's much harder to come up with an *idea* so infectious that it will travel far or last long. But people keep trying, by such means as teaching kindergarten or writing books or symphonies. Those few who achieve conspicuous success earn some of our highest admiration.

But something else happens, too, and that was the point my anonymous conversationalist in Den Haag was making. People form memetic, as well as genetic, "families." A family, in the traditional and conventional sense, is a group of people who share a large percentage of their genes—who have a lot of genetic information in common. There is probably a built-in drive, of uncertain and variable strength, to associate preferentially with those people, to protect them, and to expect them to protect you.

But an affinity group, such as a bridge club or a church or a band, is closely analogous to a family. It's a group of people who share a large percentage of their interests and attitudes—who have a lot of memetic information in common. Science fiction fans—people who read science fiction and frequent conventions or publish and read fanzines—are a good example. They share an interest in a broad body of literature, and frequently attitudes about the wide range of issues it explores. I have heard a great many of them comment that fandom feels like family—in some cases, more like family than their real families. Some of us are lucky enough to feel close to our families *both* genetically and memetically, but many are not.

In a way, this is sad, but not really surprising. Memes are information at the conscious level—the level at which individuals interact in day to day life,

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through such means as conversation. Genes are information at the cellular level, far below conscious awareness. Is it any wonder that people often feel closer to those with whom they resonate in dialogue than to those who merely have similar DNA? People *choose* their friends; their relatives are chosen for them by a genetic lottery, and may develop in quite different memetic directions.

Until quite recently, travel and communication were so difficult that most people had little opportunity to interact with people beyond the few who lived nearby. The selection available was so small that a person was not likely to meet many truly kindred spirits in the memetic sense. That circumstance probably helped feelings of family solidarity; no matter how much relatives might disagree about things, they still had more in common with each other than with most others they met.

Now, cars and planes, telephones and computer nets have greatly expanded the number of others people can associate with. They can seek out and spend time with those who think and feel much as they do, even if there aren't many of them and they live far away. The conversation I wandered into in Holland was devoted largely to speculating about how this technologically augmented ability might change the shape of society in the future. For example, might meme-based families become more prevalent and important than those based on genes?

Shocking as the suggestion might be, it does have some advantages, at least at the individual level. A good many science fiction fans, to return to that example, are people who never felt quite

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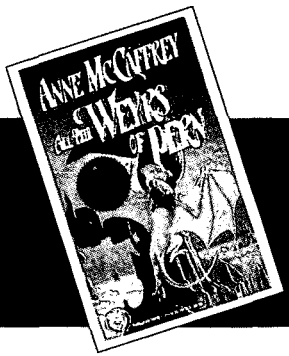
DECEMBER

THE DRAGONRIDERS' DREAM, THE WIZARDS' DREAD, AND THE STEERSWOMAN'S DISCOVERY—FROM THE FIRST NAME IN IMAGINATION.



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at home among the people they grew up among, and experienced a kind of relief upon finding that there *were* people they felt comfortable and happy with.

But there's a potential downside, too. When people gravitate toward others who think and feel similarly, the "memetic families" they form are likely to show the same tendency as genetic families to band together to defend themselves against the outside world. They may (quite understandably) tend to think of their memetic family as superior to outsiders. After all, its members share memes that they themselves have decided are better than others. This attitude shows up, for example in special jargon that distinguishes "us" from "them." Science fiction fans sometimes refer to non-fans as "mundanes" and scorn those who speak of "sci-fi"; "cavers" know that only non-cavers call them "spelunkers"; and so forth.

No doubt some groups with such feelings are at least somewhat justified: they really *do* have ideas that are better than somebody else's. Yet even they are subject to an insidious danger which is perhaps best explained by continuing the analogy between genes and memes.

The tendency to form memetic families and then avoid dialogue with outsiders can be viewed as a memetic analog of eugenics: the old idea of improving the species by selective breeding. Eugenics has always been a controversial idea, often intensely disliked and feared by many because of the real and potential abuses it lends itself to. It has been used to justify blatant racism and the atrocities of Hitler's Germany, and those are surely sufficient reason to mistrust its proponents. Yet the basic principle has more modest and reasonable applications which virtually everyone accepts and uses, directly or indirectly. American agriculture is able to feed as many people as it does largely because of the selective breeding of crops and livestock. A growing number of couples are using genetic screening to determine the advisability of their having children, or whether to carry a particular pregnancy to term. Even in selecting marital partners, they are consciously or unconsciously looking for genes that will combine well with their own.

When people try to associate mostly with others having what they see as the best ideas, they are doing something similar, but with memes instead of genes. We might logically call it "eumemics." The danger in it is the same as in eugenics: inbreeding. If two healthy people both carry a harmful recessive gene, there's a good chance that some of their children will get *two* copies of that gene and therefore suffer some more or less serious genetic problem that both parents escaped. If multiple generations are produced within a small community, it becomes more and more likely that such problems will occur. It also becomes more likely that particular traits will be completely lost, or become excessively prevalent, through the random sampling effect known as genetic drift.

Livestock or pet breeding uses inbreeding intentionally to produce a desired specialization, but such specialization usually decreases the general viability and adaptability of the breed. Domestic livestock can usually thrive *only* as domestic livestock; crops seldom "grow like weeds." To keep a

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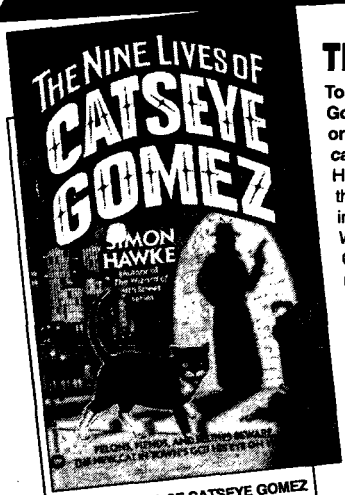

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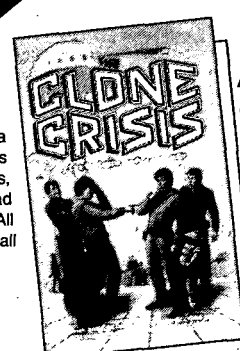

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population genetically vigorous and able to survive a wide range of possible catastrophes, it needs to keep mixing genes with dissimilar ones. Even "primitive" cultures have recognized and institutionalized this need by requiring its members to get their spouses from another village or tribe.

Associating only or mostly with people having similar ideas, beliefs, and values amounts to "memetic inbreeding," and probably has similar dangers. Creative people have often observed that the best ideas frequently result from combining two ideas which are individually less fruitful. That's less likely to happen if you talk to people who already agree with you. So perhaps those who scorn "mundanes," or whatever their particular in-group may call them, should force themselves to spend more time listening to them. ■

IN TIMES TO COME

● Our Mid-December issue brings G. David Nordley his first *Analog* cover, by Jim Burns, an artist new to our magazine but well known elsewhere in science fiction. The story itself is impressive, fun, and refreshing; a briskly paced adventure involving a human heroine and not one, but *two* memorably different kinds of aliens sharing a most peculiar planet. I've occasionally complained that too few writers now seem willing or able to create the richly detailed worlds and beings to inhabit them for which Poul Anderson has long been so well known. Nordley, in "Poles Apart," has done it. I think you'll very much enjoy his story and characters, and will look forward to his doing it again.

We'll also offer a thoughtful novelette by W. R. Thompson, a bit of seasonal silliness by William S. Davis (who brought you "Turkey Day," a couple of years back), and short stories by Charles Sheffield and Stephen A. Kallis, Jr. Plus an authoritative fact article on America's emerging plans for going to Mars, by Doug Beason, who played a role in developing those plans.

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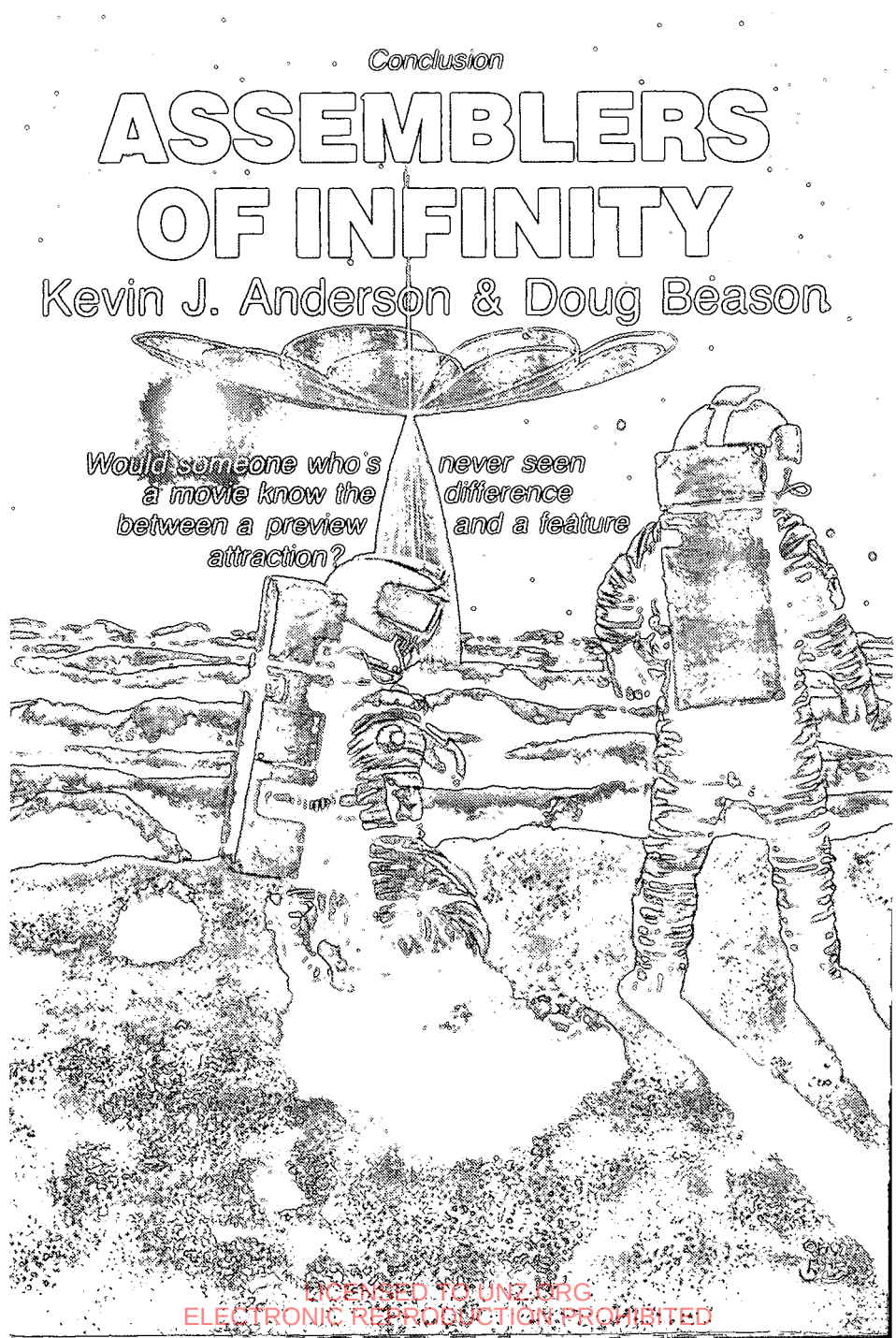

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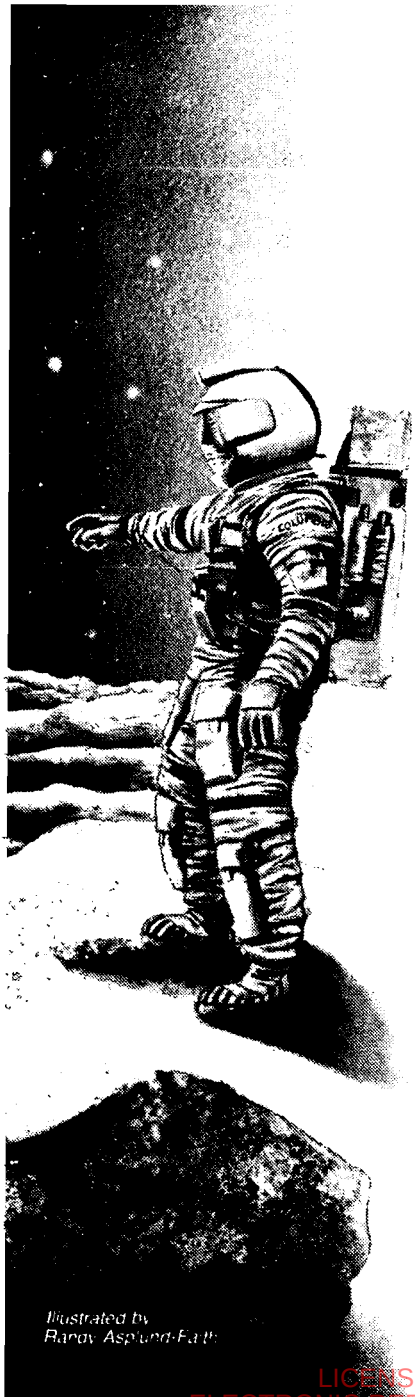

SYNOPSIS

Three technicians travel to the far side of the Moon to find out why a very-low-frequency array designed to function autonomously has malfunctioned. At the site of the array, Daedalus crater, they discover a giant excavation project, gossamerlike frameworks, the foundations of something enormous, something no human has ever built. No one has suspected it was there. The technicians radio back to Moonbase Columbus just before they are disintegrated, as the people at the base watch.

Jason Dvorak, *architect and new commander of the moonbase, dispatches a telepresence probe to the far-side crater to take readings to determine the origin of the bizarre construction—but shortly after it lands among the eerie gossamer structure, the probe* disintegrates. *The staff frantically tries to find out the reason—there's no radiation, no detectable energy surge that would destroy the probe.*

An infrared flyover of the Daedalus crater shows a "hot zone" in a circle about three kilometers in diameter surrounding the construction. Jason arranges for a sample-return mission using surface-penetrator geology probes. A contained sample is whisked off to Sim-Mars, an isolated lab on the far side of their crater.

During remote-analysis of this lunar regolith sample, they discover the culprit—alien nanotechnology machines, tiny self-replicating engines a billionth of a meter across. The Daedalus site is crawling with them, like a swarm of microscopic ants building an enormous construction, an atom at a time.

Meanwhile, back to Earth, **Celeste**

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McConnell, *director of the United Space Agency in Washington, DC, is also trying to get some answers. With her colleague, Air Force General* **Simon Pritchard,** *she watches the remote analysis on the Moon. Seeing the discovery of the alien nanomachines, Celeste promises that she will send up an expert to help study the infestation.*

Celeste contacts the Nanotechnology Isolation Laboratory (NIL) in the wastelands of Antarctica, obtaining the grudging help of talented young researcher **Erika Trace.** *Erika will leave the NIL and her mentor,* **Jordan Parvu,** *behind to go up to the Moon where she will study the alien nanomachines.*

On her way up to the moonbase, Erika stops over at the orbital waystation, Collins. *Along the way, she meets* **Bryan Zimmerman,** *or "Bryan Zed," the regular shuttle pilot, who is very straitlaced and stiff, and* **Bernard Chu,** *head of the* Collins *station. A short time before, Chu had been unexpectedly replaced in his duties by the architect Jason Dvorak, and he never quite understood the reason for Celeste McConnell's decision.*

Meanwhile, on Earth, General Pritchard meets Celeste at a crab house for lunch. Pritchard feels like an anachronism—his chosen profession is the military, but with world peace for many decades, there isn't so much use for people like him anymore. When the alien nanotech threat appears, Pritchard believes that this "outside enemy" threat would be a terrific chance for him to gain prestige and to make the military important again.

Celeste recalls how she rescued all the people in the Grissom *space station disaster, which made her a national hero and launched her career. What she doesn't tell anyone, though, is that she had had a vivid nightmare the sleep-period before, something that she feels had warned her of the disaster. Several times in her life, she has had these "prescient" dreams, and though she is embarrassed to say anything about them, she believes them in her gut. She has had numerous uneasy dreams of late, and she believes it has something to do with the alien nanotech presence on the Moon.*

On the Moon, once introduced to Jason Dvorak and the Columbus crew, Erika moves off to the isolated Sim-Mars lab and buries herself in her work. She begins to glean information about the alien machines. Her analysis reveals several different "species" of nanomachines, each having a different purpose—Assemblers, Disassemblers, Controllers, Quality-Checkers, Reprogrammers, and one type of nanomachine that is different from all the others, but she can't determine exactly what it does; it seems not to have any type of assignment.

Brainstorming with her old mentor Jordan Parvu at the NIL, the two of them speculate that the nanotech Assemblers originated from an alien civilization, hindered by the impossibility of faster-than-light travel, but yet are still willing to visit other stars. The aliens could accelerate the tiny self-replicating nanotech machines nearly to the speed of light in a "shotgun" approach to nearby star systems. Once they encounter a planet, the preprogrammed machines could then start building things, such as the giant construction

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on the far side. As a transmitting station? For a ready-made base when the aliens' own slow ships arrive? As a prelude to invasion? Erika and Parvu have no way of knowing.

At the moonbase itself, Jason studies the growing alien construction. He compares photos taken over weeks and sees the gradual change, gathering some sort of idea of how the artifact is taking shape. He runs CAD/CAM simulations, trying to determine what it will be.

Finally, when Erika believes she has learned everything she can about the Assemblers, she is homesick and wants to come home for a respite, to gather up new equipment, and to hand-pick some assistants. All of the Disassemblers in her samples have disappeared and she cannot figure out where they have gone. Meanwhile, the construction at Daedalus crater continues to assemble itself according to the alien blueprint carried by the nanomachines.

Parvu himself pulls strings to get Erika released from her duties. She gets on a return shuttle to go back to Earth, but is forced to spend a few days on the Collins *until the next shuttle run home. While performing a routine blood test on Erika, Bernard Chu discovers that her body is infested with the alien nanomachines—and so is everyone else on the* Collins*!*

In the middle of the night, Celeste McConnell is awakened by a direct, private communication from Bernard Chu on the Collins *station. She has been having more of her terrible nightmares and she knows it will be bad news. Panicked, Chu tells of the nanomachine infestation. Celeste tries to calm him and tells him to wait until she figures out something. Pritchard is there in bed with Celeste, but the two of them realize the gravity of the situation on the* Collins*. The station crew can't allow the Assemblers to get to Earth, where they might well take apart the entire planet. All it would take is a single self-replicating nanomachine to start the whole process. Celeste agrees. Everyone who has had contact with the alien nanotech infestation must be totally quarantined from Earth.*

Celeste orders everyone to evacuate the Collins *station and to go to Moonbase Columbus. They all pile into Bryan Zed's shuttle and as they are heading away in orbit (and unknown to them), Celeste triggers the* Collins *self-destruct sequence. Now no one can ever go back there, and the refugees wonder how they will ever get home.*

The Moon is quarantined. The shuttle and station people are upset at Erika when they find out that they have been infected. She is their scapegoat; if she hadn't been careless somehow, none of this would have happened. On Earth, there is also panic at their "close call." General Pritchard has appeared as an advocate, warning of this alien threat. Supreme conventional weapons won't do a thing against a nanotech invasion!

Erika, a loner anyway, is more concerned with her "infection" and tries frantically to solve it. What will the Assemblers in her bloodstream do to her? She is in touch with Parvu and together they figure out that the Assemblers seem to have switched into a different mode while in organic material, either dormant or just analyzing her. The reason the first three Daedalus technicians died

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was because the Assemblers breached their suits in a vacuum, not because of the nanomachines taking their bodies apart. She takes no comfort from the nanotech assemblers being dormant, though—the infestation could reignite at any moment, and she will have only a little time before the Assemblers destroy her from within.

Terrified, Erika manages to modify the existing sample Assemblers in her lab, to reprogram them so they will not replicate themselves, to make them seek out and destroy other Assemblers, then shut themselves down. She injects herself with these modified "Destroyers," comparing them to white blood cells that will seek out and tackle an infection. After growing ill, Erika finds that her body has been purged of the nanotech infestation—and so has everyone else. The "Destroyers" have spread from person to person in the same manner that the original infection did.

With Erika cured and all the others clean, elation grips the base. Chu tries to get the lunar quarantine lifted, but Celeste McConnell and General Pritchard are reluctant. They will hold off for the time being; too many unanswered questions. Supplies continue to come to the Moon by robotically controlled ships geared for one-way use only, to ensure that no one can commandeer a vessel back to Earth.

Out of frustration, Chu and Bryan Zed get direct permission from Celeste to reconfigure one of the telerobotic rovers. Remotely piloted by Bryan Zed, the rover delivers a homemade bomb to farside. The weapon explodes and destroys part of the alien construction site—but like an anthill, the Assemblers

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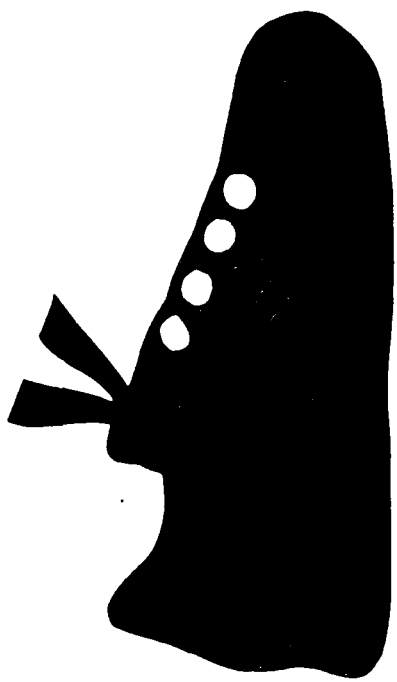

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rebuild the site as quickly as it was taken down. And what is worse, whatever the alien Assemblers are building, it looks as if it might be completed soon.

Meanwhile, all kinds of turmoil takes place on Earth. Pritchard becomes a public figure. Factions on Earth clamor to destroy the Daedalus construction and Moonbase Columbus altogether; another faction wants to study the aliens to learn what they want and to greet them. Pritchard announces a compromise: he will retrieve some old nuclear warheads from Cold War days and they will be shipped to the Moon, where they will be placed in a ring around the alien construction. That way, it will be a "safety valve," a defense in place just in case they need to use it.

Meanwhile, Erika's experiments with her infection-destroying nanomachines have given Jason an idea to turn her reprogrammed "Destroyers" against the original concentration at Daedalus. "Fight fire with fire," he says. Doing this might wipe out the entire infestation, like a vaccine. Jason has been working closely with Erika, and he feels comfortable around her. Although both of them deny it, a fledgling romance is developing between them.

Erika cooks up a bunch of her self-replicating Destroyers and turns them loose on the farside. The Destroyers work for a while, chomping through the swarming nanomachines around the construction, and the idea looks to be a complete success—but then a new form of alien nanotech machine appears (like an immune defense system). The Reprogrammers have found a defense against Erika's meddling. The pace on the alien construction picks up, and the Assemblers have learned how to defend themselves against anything the humans can throw at them. Nothing will stop the completion of the construction now.

PART IV

CHAPTER 23

Alpha Base: Wendover Air Force Base, Utah

"Got your bearings yet, General?"

"What?" Simon Pritchard cupped a hand to his ear and leaned close to the young major sitting next to him. Wind whipped through the back seat of the helicopter, making it difficult to hear. Up front, the pilot didn't even try to speak, circling the restricted airspace.

Major Felowmate yelled out, "I said, do you know where we are, sir?"

"Not sure—first time I've been to Alpha Base."

The major gestured over the seat in front of them. "We're heading west—Nevada state line is two miles in front of us. I-80 is twenty miles to the north, and Wendover is just behind us. We're sitting on top of Alpha Base right now."

"Sure got here fast!" Pritchard shouted. He looked down at the gaping crater called Alpha Base. He could see bunkers set into the ground and dotting the crater walls like shacks in a strip mine. "Why aren't we landing yet?"

"Getting final approval, sir. Priority one restricted airspace! We'd be shot down if we didn't have special electronic equipment on board to identify us as 'friendly.' "

Pritchard snorted and leaned back into his jump seat. As a scientific officer, he had never had to live in close

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quarters with operational military men.

Felowmate turned around in his seat as the pilot made a sudden motion in front of them and pointed out the cockpit. Felowmate gave the woman a thumbs up, then turned back to Pritchard. "Just been cleared to land."

Pritchard nodded and turned to look back at the ground. Desert stretched out on either side, broken only by the four barbed-wire fences that encircled Alpha Base. To the west lay the mountain ranges of Nevada; he could see Wendover AFB to their left, and the long runway where the Agency plane had landed him only twenty minutes before.

Built a good forty years before as a nuclear weapons storage site, Alpha Base held the majority of America's remaining warheads. Most had been dismantled, but a few of the "safest" devices remained here, watched over by an extensive International Verification Initiative team.

As the helicopter bumped to the ground, Major Felowmate ducked, jumped from the craft, and motioned for Pritchard to follow. The pilot remained in her seat, saluting Pritchard as he climbed out.

The hot, dry air hit him like a blast from an oven. He and the major scuttled away from the Blackhawk helicopter toward a caravan of waiting cars. The helicopter's rotor blades whipped dust up in the air, making Pritchard's eyes sting.

As they approached the cars, uniformed guards on either side of the lead vehicle snapped to attention. Both carried automatic rifles. A woman in a white dress got out of the car. Her blond hair was braided into a bun and her white stockings made her look like a bizarre hallucination in the bleak wasteland. She held one hand to her hair and the other shielded her eyes.

Pritchard heard the helicopter roar back into the air toward Wendover AFB. After a few seconds the thrumming noise had settled enough for him to hear and think clearly for the first time since he had landed in Utah.

Major Felowmate made the introductions as they walked up to the waiting group. "General, this is Francine Helschmidt. She's our International Verification Initiative liaison officer out of Salt Lake City."

"General." Her grip was firm and her eyes hard as volcanic rock. "Glad to be of help."

"Thank you." Pritchard looked around at the rest of the caravan. Now that the dust from the helicopter had dissipated, he could see that the four-wheel-drive vehicles were painted Air Force blue. Each held a military driver, several civilians, and what appeared to be an armed guard. Pritchard nodded toward the other people. "These are the IVI observers, I take it?" His voice rang in his ears, still vibrating from the helicopter ride.

"That's right, General." Francine Helschmidt handed him a list of names. "They've been cleared through appropriate channels. We have assured them that once the seals are broken on the storage bunkers, they will watch your every move. We need to make sure you get only the specific warheads to which you have been authorized."

Pritchard did not like Helschmidt's cool tone. He cocked an eyebrow at her. "You mean 'nuclear devices,' don't

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you? I'm not going to use them as warheads. We're not going to war. They are a protective measure against an extraterrestrial threat."

Helschmidt stood with her feet apart and her hands stiff at her side. "We might as well call a spade a spade, General—there was no reason to have produced these things other than for going to war."

"Really?" Pritchard drew his lips tight. He had met people like her before, and at times he found it amusing to push their all-too-obvious buttons. In this case, though, he had no time to play games.

"Yes, really, General," Helschmidt said. "But that appears to be a moot point, doesn't it? You have received your approval. Whether you call them warheads or not, we've been instructed to ensure that only six 'devices' are removed from the storage bunkers. I have already studied your security plan for transporting the weapons, and I believe it might be effective, provided you run into no unforeseen difficulties."

Pritchard refused to react to her comments. He had run the security plan through expert sabotage teams, challenging anyone to come up with an ambush scenario that would successfully divert the devices from their intended delivery point. Now he understood her—Helschmidt didn't know what the hell she was talking about, but wanted everyone to think she was important. He wondered how she had managed to reach her present position.

"Thanks for reminding me, Ms. Helschmidt. Now, if we could go about our business?" Pritchard turned to Major Felowmate, who gestured to the lead vehicle. Opening the front door for her, Pritchard nodded to Helschmidt. "Please have a seat."

"I'll sit in the back, General."

"I insist."

Helschmidt stepped up into the vehicle. Pritchard slammed the door and moved to the rear seat, where Major Felowmate held open the door, then climbed in beside him.

The caravan of vehicles lurched into motion along the dirt road as soon as Pritchard had buckled his seat belt. The road was dusty and full of potholes and scrub brush.

Helschmidt turned in her seat. "Major Felowmate, I assume you have the secondary holo-key."

Felowmate patted his chest. "I've got it." To Pritchard, the major explained, "The storage bunkers need two holographic keys to produce the interference pattern necessary to open them. One key is kept by the IVI Institute while Alpha Base holds the other. Without both, it is impossible to open any bunker."

Pritchard had heard of such keys. Lasers could produce a nearly infinite number of interference patterns. Without the exact sequence of spatial frequencies, no one could break the code to open the bunker.

The vehicle bounced as the driver tried to find the smoothest part of the road. Pritchard watched the landscape for a few moments before he spoke again. "So, how long have you been with the IVI, Ms. Helschmidt?"

She brushed back her hair. "This is my second year. I was appointed by the administration to this post after the election."

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"So you've had experience in disarmament before, I take it?"

"Actually, no. I headed a small PR firm in Washington before this. I was part of the advance team for the president's campaign. I was on the road for most of a year and a half, visiting every small town on the map, getting people inspired for the president's visit."

Pritchard nodded, but forced himself not to speak. He had learned to put up with a lot during his fast-track Air Force career, where politics always made the job more difficult. Yet most of Pritchard's own assignments had grown out of being in the right place at the right time. He thought of Celeste McConnell and the positions she herself had held. *Now that was definitely luck*, he thought. Everything from escaping the *Grissom* destruction to her promotion at the agency.

Major Felowmate leaned to the front of his seat and directed the driver around to the front of an array of white concrete bunkers. "Those are the ones."

Behind them, the caravan pulled into a semi-circle. Three storage bunkers faced each other, 120 degrees apart. The bunkers stood twenty feet high, fifty feet across, and a hundred feet long, covered with a dirt berm. At least five hundred bunkers dotted the crater, each one with metal searchlights affixed to the top, each one displaying the three-bladed international radiation symbol painted in magenta and yellow.

Felowmate nodded toward the closest bunker. "Here we are, General."

Pritchard joined Francine Helschmidt out on the concrete apron in front of the nearest bunker. She smoothed her skirt, though wind continued to flick it around her knees. Pritchard noticed a half dozen modified-Sikorsky helicopters hovering at various points around Alpha Base. Watchdogs. He turned to Felowmate and pointed at the choppers. "Are they providing security for us?"

"And against you," Francine Helschmidt said. "Just in case anything goes wrong."

Felowmate answered Pritchard. "Three of them are, sir. The other three will land to take you and the devices back to Wendover, where you'll load them on the transport plane."

"Why three helicopters to carry only six devices? I requested tactical nukes, not something that needs a crane to lift."

The major nodded. "The other two copters are decoys, sir. We don't want anyone to know which one actually has possession until the last possible moment—terrorists, you know."

Escorted by security policemen, three men walked up to them from the other vehicles. They were led by an overweight man who carried his jacket over one arm; dark semicircles of sweat seeped from his armpits as he wiped at his face with a handkerchief. Beside him, a small thin man also sweated, but he seemed determined not to make an effort to cool down; his suit looked two sizes too big for him. The third man wore a loose-fitting short-sleeved shirt. Swarthy and with a medium build, the man looked comfortable in the desert. Of the three, only he grinned at Pritchard. He held out a hand and spoke with a British accent. "Major General Pritchard, pleased to meet you. Francine has briefed us on what to expect. I

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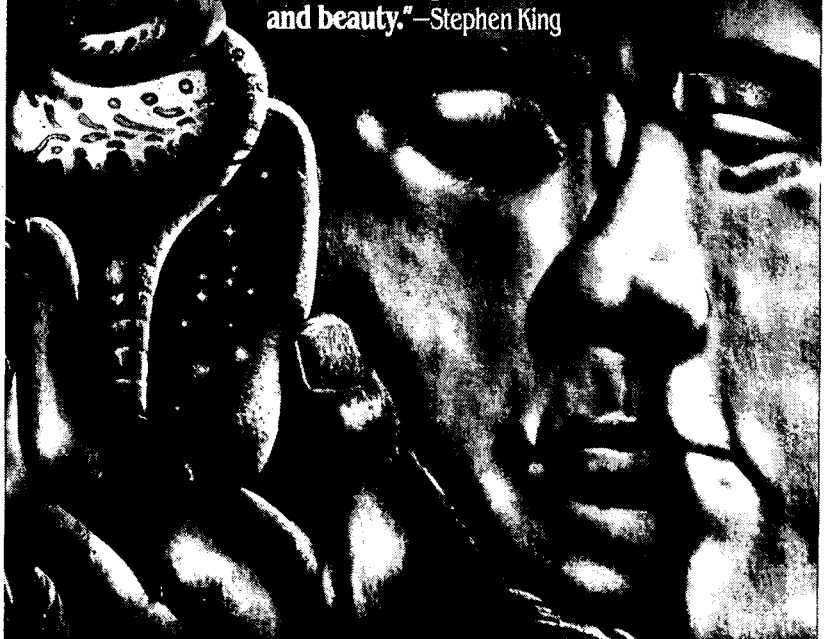

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look forward to expediting matters."

"Thank you," said Pritchard. He turned to the other two men but they merely nodded.

Helschmidt said, "Well, General. This is the rest of the IVI on-site verification team. Are you ready?"

"Let's get moving."

Major Felowmate stepped to the bunker door, unbuttoning the top of his khaki shirt. He pulled on a chain around his neck to withdraw a squat rod that looked like a tiny flashlight with bumps dotting the base. "Ms. Helschmidt?" She fumbled with a chain about her neck and withdrew an identical-looking rod.

The major motioned to the security policemen to stand aside. The guards stood around the bunker in a semicircle, facing outward with weapons ready. Pritchard glanced around the empty desert, trying to find any evidence of a threat.

At first it seemed ludicrous to Pritchard that such precautions were being taken deep inside of Alpha Base, already past four barbed-wire fences and dozens of intruder-prevention measures. Perhaps the extra show of security was to impress either himself or the IVI team.

Major Felowmate escorted Francine Helschmidt and Pritchard around to the side of the bunker. A shoebox-sized panel protruded from the wall at shoulder height. Felowmate motioned for Pritchard to step back. "Stand outside of the red lines, sir. That's where the bunker doors will swing open."

Pritchard took a step back to be completely away from the semicircle only half-visible on the dirt-covered concrete slab.

Felowmate wiped dust from the top of the box and squinted at a number engraved on its surface. "SK-3452," he said. He checked a number written on a small card he withdrew from his pocket. "This is it. Double-checked." Both he and Helschmidt made some sort of adjustment to their keys.

Pritchard fidgeted on his feet in the desert Sun. He should have delegated the tedious retrieval task to someone else—but he wanted to keep this under his own close supervision.

"Bunker number is keyed in," said Helschmidt.

"Have you done this before?" Felowmate asked her.

Helschmidt hesitated. "No." She seemed embarrassed, but Felowmate ignored it. "I'll go first. You'll have ten seconds to insert your key or every alarm on base will go off. Ready? Here goes."

Felowmate inserted the squat rod into the box. Beside him, Helschmidt added her holo-key to an adjacent receptacle. Inside the shielded box, lasers scanned the keys' interference patterns. A green light glowed at the bottom of the box.

"Please wait until the doors stop moving," Felowmate said as the two massive doors began to crawl open, like the gaping entrance to some ancient tomb.

Felowmate said, "Each one of these steel doors weighs somewhere around twenty tons. They're five inches thick and reinforced with rebar—built to withstand a twenty-thousand-pound bomb going off right next to them."

When the doors stopped moving, they looked like the giant jaws of some

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behemoth, waiting to swallow anything that came too close. "General, Ms. Helschmidt?" Felowmate motioned to them, then pointed toward the waiting security policemen. "Smitty—you, Witz, and Dardanelle follow us in. You know the drill."

"Yes, sir," all three answered at once. They drew up their weapons.

Felowmate said, "They've got orders to shoot, General, if anyone tries anything."

Pritchard smiled to himself. "Don't worry, I won't."

"We are waiting, Major," said Helschmidt. She stood by the entrance with the other three members of the verification team.

When they stepped into the shadows, a hint of coolness along with a musty smell wafted from the bunker. The small man in the big suit pulled out a computerized notepad. He made notes with a stylus as they entered the bunker. Stark screened-in lights cast shadows across the floor. Yellow lines were painted on the rough-surfaced concrete.

Felowmate pointed to a yellow band. "Follow the yellow brick road, please—we need you to stay inside the path." He turned to Pritchard. "The devices are dispersed here inside the bunker. Can't risk having too many nukes too close together, otherwise the probability of spontaneous fission goes up. Too many stray neutrons in the air."

As his eyes adjusted to the light, Pritchard could see corridors running off in different directions. After walking past two intersections, Felowmate stopped and pointed toward the right. "This is the chamber we want. Ms. Helschmidt?"

They approached another steel vault door. A second shoebox-sized panel, identical to the one outside, was embedded in the wall. Felowmate extracted his holo-key. "Same procedure as before."

After inserting their keys, he and Francine Helschmidt stepped back and allowed the vault door to open. Felowmate said, "This is it, General. Here're your nukes."

If the alien artifact on the Moon turned out to be an immediate threat, and if Pritchard had to jump through this many interlocks and double-checks before they could use their defenses, they might just as well kiss Earth goodbye. He would have to speak with Celeste about streamlining the command-and-control process.

Pritchard waited for the major to enter the chamber first. When no one moved to accompany him, Pritchard stepped inside the vault himself. He saw ten white cans the size of oil drums, each inside a yellow barrier circle painted on the floor.

"Storage containers, sir," said Felowmate. "They're equipped with PALs—Permissive Action Links, a device that can disable the devices if they're stolen. There's also some other nasty protective things embedded in the containers in case somebody tries to screw around with them, but we can't talk about that."

Helschmidt and her team stepped into the chamber. They walked around the containers, using a microbar-code reader to verify each device. Satisfied that the right warheads were where they should be, Helschmidt pointed to six of the containers. "These are yours, General."

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Pritchard nodded. "If the alien nanomachines become a threat, these weapons may be our last hope. If I need to wrestle red tape to get a quarantine ring in place, I'll put up with it."

"Good luck, General," Felowmate said.

"Save your luck for the people up on the Moon. They need it more than I do."

Felowmate nodded to the security policemen still standing guard outside the vault door. "Smitty, get a crew in here to take these away. General Pritchard will give you instructions."

Francine Helschmidt leaned forward and spoke to Pritchard in a low voice. "Don't make us regret this, General."

CHAPTER 24

Daedalus Crater, Farside

Bryan Zed would look right at home chewing on a stalk of grass, Jason thought. Even in a space suit, the silent shuttle pilot gave the appearance of a good old boy as he went alone on his mission across the desolate Farside terrain—not quite a redneck, just someone who was honest and straightforward to the point of parody.

After Zimmerman lay down in the rover bed to keep himself from being seen, the vehicle sped away. Agency Mission Control and everyone watching on the newsnets thought the rover was simply a telepresent inspection vehicle commandeered by Newellen. But Zimmerman had volunteered to try something of his own. A long shot, of course, but the people at Columbus really had nothing else to try. Or to lose.

Jason stood with Big Daddy Newellen and Cyndi Salito on a small rise ten kilometers away from the Daedalus site. Even from this distance, Jason could make out details of the sprawling weblike construction, like a spun-glass sculpture at the edge of the VLF array. The huge flowerlike central structure—some sort of receiving dish?—glistened in the harsh sunlight, along with the humps of support buildings. The entire thing was opaque and well defined now. Within the last few days the complex had taken on a new look of solidness.

"That sucker looks almost finished," Newellen said into the suit radio. "And to think it's been only six weeks since we found it."

From their position, the three space-suited people also had a good view of where the Agency's shuttle would land. The ship would be carrying six nuclear warheads for them to deploy around the alien construction. To destroy it as a last resort.

This certainly isn't the reason I came up to the Moon, Jason thought. He glanced at the chronometer projected onto his faceplate by the heads-up display. "Five minutes," he said.

"Right on time," came Cyndi's voice over the radio. "I just hope they land in the right place."

Newellen snorted in the suit radio. "I'd hate to think what six atomic bombs will do if they miss the mark and slam into us."

"Bad for you, lucky for me," said Zimmerman from the rover. Jason wondered if he had caught a trace of humor in the man's transmission.

"They're not armed yet," Cyndi said. "We have to activate the PALs when we bury the devices."

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"Shut up, you guys," said Jason. "We're going live any minute now. We don't want them hearing Cyndi's voice." Salito had worn Zimmerman's name patch, just in case remote cameras happened to catch the ID.

Jason heard a click over his earphones, then Bernard Chu's filtered voice. "Jason, Columbus here. We show the L-2 link has been established. We've got an updated vector on the robotic ship. They're pegged to land right on schedule."

Chu still sounded nervous about setting the warheads in place. He had changed his attitude dramatically after the non-nuclear bomb had not caused as much damage as he had hoped, and Erika's nanocannibal "purge" of the site had failed. Jason couldn't blame him—what if the nanocritters decided to retaliate? They had certainly received enough provocation. Or was Chu perhaps more concerned with Celeste McConnell's agenda, resenting that she was running the show while sitting safe on Earth?

Jason clicked his chin-mike. It would take three seconds for his voice to travel up to the L-2 relay station, all the way to Earth, then back up to Moonbase Columbus. "We're ready out here, Columbus. If anything goes wrong with the landing, you'll know when we do. You'll just be around to enjoy it longer."

Jason remembered reading about catastrophes that had occurred transporting nukes during the Cold War days—bombers crashing on takeoff, weapons inexplicably "dropping" from bomb bays, midair collisions where some warheads had actually been lost. . . .

Intellectually, he knew that the frequency of these accidents was far above what the law of averages would predict. But standing out on the surface of the Moon and waiting for an autopiloted machine to bring down the equivalent of more than twenty million tons of high explosive only a kilometer away, he felt weak in the knees.

The nanotech threat ten kilometers away didn't make him feel any better.

He didn't know how Zimmerman could find the guts to be there when the robotic shuttle landed. Especially when he claimed to distrust autopiloted systems.

"One minute," said Chu.

Jason turned away from Daedalus and looked up. He scanned the star-sparse sky. The Sun was still up, glaring down on the landscape, though the sky remained black with no atmosphere to scatter light. Farside had another three days before the Sun would set for two weeks.

Cyndi Salito's voice broke the silence over the radio. "Got it!" Then she abruptly silenced herself, remembering that she wasn't supposed to be saying anything. She pointed due north of Daedalus, thirty degrees up from the horizon.

Jason could see a patchwork of stars, fighting the glow from the Sun. He caught a movement out of the corner of his eye. There, just below Corona Borealis, a light grew brighter every second. The ship had already passed through the L-1 point and descended through a quick polar orbit about the Moon.

The giant alien construction towered

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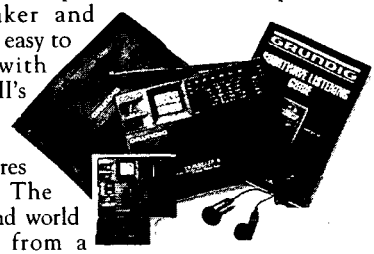

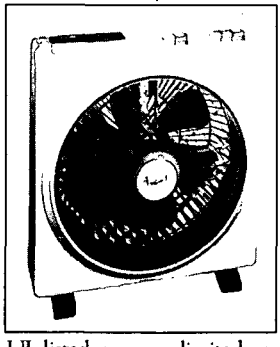

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over the floor of the crater in perfect silence, motionless. On Agency Select and the other channels Moonbase Columbus could tap, Jason had seen signs of the fierce debate still going on back on Earth about the purpose of the structure. Was it some sort of antenna for communication? A giant solar collector? A cosmic ray analyzer? A work of art, like Alexandre Eiffel's tower on Earth?

The whys bothered Jason even more now than before. He himself was helping to set in motion the destruction of the artifact, and whatever purpose the alien structure had in store. As an architect, it offended him to knock down something so spectacular out of paranoia. As an inhabitant of Moonbase Columbus, though, the thing scared the bejesus out of him.

The bright spot of the incoming shuttle grew quickly enough that Jason could discern features. *What if it misses the landing site and hits the artifact itself?* What would happen if the nanomachines got to the warheads before someone had a chance to detonate them? Surely, the Disassemblers could render all the electronics inert in only a few minutes. Would Director McConnell have the warheads already primed and ready for immediate remote detonation, just in case that happened?

He recalled McConnell's skepticism that the nanocritters had really been purged from the bodies of the moonbase inhabitants. Had McConnell intended to detonate the warheads all along, to wipe out the artifact—and most of her problems—while claiming it had been an accident?

Sweat broke out over his body, forcing the spacesuit systems to work overtime. The possibility sounded so reasonable to him that he could not shake the idea. Jason started to speak his doubts, then decided not to voice them on open line. He barely had time to make out the spindly legs of the shuttle's landing pods as it came down, right on target, right on schedule.

Jason closed his eyes and let out a silent sigh of relief.

"Another perfect landing," Newellen said, raising his suited arm high in the air. "All hail the auto-pilot." The movement in the constant-volume suit caused his other arm to cock back.

A rude noise came over the radio, most likely from Zimmerman.

Jason clicked his chin mike. "We've got a visual on the landing, Columbus. The rover will reach it shortly to unload the warheads." On cue, he saw the rover bouncing along out to the landing site.

They still had the task to unload the nukes and deploy them around Daedalus, just outside the hot zone. Six warheads, each equivalent to over three million tons of TNT. If this didn't finish off the "gigathreat via nanotechnology," nothing would.

Once they had the defensive ring in place, the next move would be up to the alien artifact.

Lon Newellen sat hunched over the controls of the telerobotic rover. "Easy now," Cyndi whispered, looking over his shoulder.

A thin sheet of sweat glistened on Newellen's chubby face. He didn't look up from the controls. "No shit."

Jason joined them at the aft of the

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hopper that had taken them to the Farside. All three had flipped up their faceplates to breathe freely in the sealed cabin.

"Sorry." Cyndi stepped back and flashed Jason a nervous smile. Jason nodded wordlessly. Newellen was doing fine.

Newellen used the rover's robotic arms to reach inside the shuttle. Zimmerman was nowhere in the rover's narrow field of view—just as planned.

The shuttle's hatch slid open. *What if the Agency had booby-trapped it?* Jason thought of the "To Whom It May Concern" letter Chu had found in the last supply shuttle. Would they have thought to do the same thing here?

The six weapons were contained in the white storage barrels from Alpha Base. Everyone had watched the tapes of Major General Pritchard supervising the loading of the nukes onboard the transfer rocket from Cape Canaveral. Everyone knew that the weapon cores were supposed to be harmless until armed by the Permissive Action Links, but Jason still felt nervous. He couldn't imagine what Zimmerman must be feeling as he scrambled to keep out of sight.

Newellen worked the robotic arms. Once he had managed to stand the first on the back of the flatbed rover, a second white container came quickly out of the hold. He was getting the hang of it.

At one point, Jason caught a flash of a white suit at the fringe of the field of view—Bryan Zed trying to keep out of the way—but Newellen quickly swiveled the robot's viewer and focused on hauling the remaining warheads out of the cargo bay.

Newellen withdrew his hands from the virtual controls and mopped his forehead. "Cyndi, get me a bag of apple chips out of the emergency stash. Then I'm ready to deliver these babies."

Munching, he took the controls again. Ahead of him on the area map, they watched the blip of the flatbed rover move away from the shuttle's landing site. In bright colors, the map showed the edge of the Daedalus hot zone, along with bright spots to indicate where the warheads should be placed. "It'll take me about an hour to drop off all six."

"Gives Zimmerman plenty of time," Jason said.

As Newellen drove the predetermined path around Daedalus, he stopped at each designated spot. He seemed a lot less nervous now, stopping for only a few minutes at each point, reaching in back of the flatbed with the robotic arm, and depositing one of the white canisters on the lunar surface. There was no need to place them with any finesse. If the nuclear ring were detonated by Earth command and control, a few feet of powdery regolith would make no difference.

Jason remained tense as the operation continued. They had heard no word from Zimmerman, nor did they expect to for at least another fifteen minutes.

One after another, Newellen deployed all six warheads. "I deserve a pizza when we get back to the base," he said.

Finally finished, he had encircled the three-kilometer-wide danger zone of Daedalus and returned to the remote shuttle. He motioned Salito to silence,

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then leaned into the intercom. "Columbus, mission accomplished and we're about ready to bring the rover on back."

"Rog. Have you taken care of everything?" said Bernard Chu. They all knew what he really meant.

"Just about. We're dropping the L-2 link while we remotely service the rover. Be back up shortly."

"Good luck."

As soon as Chu's voice stopped, Newellen flicked off the link. He threw a glance back at Cyndi. "Any luck?"

She fumbled with her equipment. "I'm trying a direct line of sight now."

Jason leaned toward the controls. Newellen tapped the panel. "Come on," he growled. He glanced at the clock. "They'll only believe us being out of touch for a few minutes."

Salito looked up. "Got him." She ran a hand over an array of lights. Bryan Zed's voice came over the new radio link. "—as well forget it. The bastards have done it again."

Jason leaned into the intercom. "Sabotaged the fuel tank?"

"That and worse. They have a shitload full of explosives wired up to the controls. I could probably get around it in a few hours, but who knows how happy their trigger finger is? I guess they figured if we found a way to get around the fuel tank being sabotaged, they would just blow the whole thing up."

With a sinking feeling in his stomach, Jason took in a breath. "OK, Bryan. Get the hell back here. Hop in the rover and get on board before Earth suspects something's up."

"Rog," said Zimmerman.

Jason slumped in his chair. They had hoped to make off with the shuttle after they unloaded the nukes. Once brought back to Columbus and given enough time, they could have found some way to fly it back to Earth. They would have at least had an option.

But who would have figured that McConnell still wouldn't trust them?

CHAPTER 25

Moonbase Columbus

"We left the stereochip right there so we could watch every detail," Newellen said, paying no attention to where he was driving the rover. "But if somebody decides to trigger those nukes, we won't see a thing. The prompt gamma rays from the nuclear explosions will fry the chip's circuits before we see any of the really cool stuff."

"They aren't supposed to just push the button from Earth," Cyndi Salito objected. "We're the ones in danger up here."

"Uh huh," Bryan Zed said. No one could tell if he intended any emotional undertone to his remark. The rover continued to follow the dim starlit path leading from the hopper's landing pad toward Columbus.

"Wait a second," Jason said, "that's all just a last resort measure, a fail-safe in case the Daedalus thing takes some aggressive action. Nobody's just going to blow it up."

"Uh huh," Bryan Zed said again.

"Jase, who do you think has the say on activating those warheads?" Newellen asked. "The president, sure, and probably Director McConnell, since she's in charge of all this mess, maybe even General Pritchard. But can anybody tell me why it is that we—you

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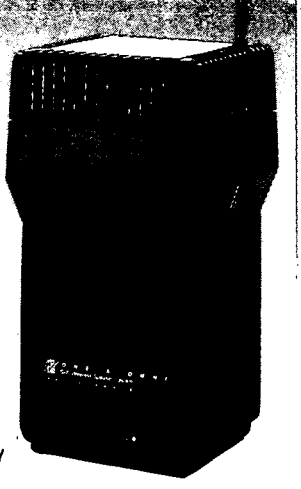

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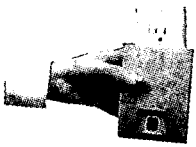

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know, us folks who have our butts right on the line—don't happen to be in the loop?"

Jason had no answer. He knew only that McConnell had seen fit to sabotage the warhead delivery shuttle—and he couldn't even complain about it because then she would know they had tried to go behind her back and retrieve the spacecraft.

"Just pay attention to the drive, Big Daddy," Jason said. "It's too dark to see where you're going." It was nightside back at Columbus, and Newellen had already barely missed several boulders large enough to ruin the vehicle.

They had been quiet nearly the whole trip back in the hopper, lifting off from Farside and returning to the landing area twenty kilometers out from the moonbase. It was Columbus's last hopper, and Jason felt uncomfortable using it too frequently.

The crew's silence had been caused by pondering the nuclear noose around Daedalus. Or maybe it had been their last view of that shuttle lying like a beached metallic whale—intentionally crippled by the Agency just so the moonbase crew would have no chance to escape.

The lights of Columbus shone out from the half-buried modules and the shielded dome of the control center. Jason spotted a spacesuited figure emerging from the main airlock under a mound of regolith. "Looks like we've got a welcoming party."

"Or the bearer of bad news."

"OK, as soon as he signals, go ahead and switch off LOS communications, then break radio silence. Cyndi, you keep quiet, though, since you're still not supposed to be with us." Jason was growing tired of line-of-sight transmissions, which required them each to be in sight of the appropriate receivers just to have a simple conversation.

Newellen slowed the rover to pull under the sunshade near the airlock opening. "Here we are folks, back from saving the world. Please feel free to throw money, wine, or women," he said.

"Big Daddy, shut up," Salito said, still on the line-of-sight link as she climbed down from the rover. She brushed dust from the vehicle. "You're starting to drive me crazy."

Newellen made a rude noise. "Risk your life for all mankind and look at the respect you get."

As if they had rehearsed the action, the smaller forms of Bryan Zed and Cyndi Salito picked up Newellen's hulking suit in the low gravity and carried him struggling to the airlock station. Jason blinked at their sudden exit, as the other spacesuited figure activated and shut the airlock door for them.

"Hi, Jase."

Jason turned at the voice. The figure now stood next to him, assisting him in wiping black lunar dust off of the rover's more delicate components. He recognized Erika's face through her helmet. He brightened, happy that she would come out to see him.

"Hi yourself."

Erika laughed. "Glad you all are back." She hesitated, then looked around. "It's kind of hard chatting in a space suit."

"Especially with everybody listening in." Jason imagined he could see her blush, even behind her visor, lit by sta-

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tus lights inside her helmet. Line-of-sight communication might be private enough, but . . .

He turned off his radio with his chin control and stepped up to her. He touched his helmet against hers and said loudly, "Turn off your radio." He made a pantomiming sign with his hand.

She looked puzzled, then moved her chin against the lower part of her helmet. Jason took a step back and glanced at her Suit Status Display—the LED marked RADIO burned red. They clicked helmets again. "Now you've got your privacy."

"You sound like you're shouting from the bottom of a fish tank, but I can understand you fine. Low-tech conquers all."

Jason waited for her to say something, but she remained quiet. "Anything the matter? Why did you come out here in person? Just to greet me?"

She paused for a long moment. "I guess I needed someone to talk to."

Jason smiled to himself. "Thanks." He touched a gloved hand to her spacesuited arm. The silver fabric felt rigid even through his padded hands. He felt warm inside that under all this pressure Erika wanted to be close to him, that she could talk to him. They had spent a great deal of time together at Sim-Mars. Why did she insist on being alone all the time? She was so intelligent, attractive, but tough—her South Carolina accent and her demure attitude sometimes made her appear soft and helpless, but Jason knew better. Being around Erika made his breath quicken.

Compared to her, Margaret was the Wicked Witch of the West. He wondered what his wife, his ex-wife-to-be, was telling young Lacy and Lawrence. Since Jason couldn't be there to show them love of his own, the children had no choice but to listen to her anger and her bitterness. Margaret had obtained an unnecessary legal separation. Just how much more separated could they be, with her on Earth and him quarantined on the Moon? Or maybe Margaret just wanted to keep the legal work nice and tidy so she wouldn't have any complications about seeing her friend "Perry."

Erika pulled her helmet back, breaking audio contact. She moved her hand up as if to brush back her hair, but stopped when her glove hit her helmet. All Jason could hear now was his own breathing. He pulled her toward him, touching helmets again.

"Come on. Let's get inside. They're going to get a new IR scan of the crater."

They were alone in the ready room as they hung up their gear, going through the meticulous motions of detaching all the suit-component interlinks, "dismounting" from the main body core. Air whooshed around them, trying to remove lunar dust that might have escaped the electrostatic curtain. As they left for the main corridor, Jason glanced up at the SAFETY FIRST sign that glowed above the inflatable airlock. He shook his head—the quiet reminder seemed ironic with everything that had happened.

Making their way to the control center, Jason felt clammy in the moonbase's air conditioning. His powder-blue jumpsuit was sweaty. When they stepped into the central dome, Chu nod-

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ded to them. He said nothing about the sabotaged shuttle. Chu turned his attention back to the holotank and said, "We've got an estimated TOA of three point six minutes for the next javelin."

It took a full two seconds for the confirmation to come back from Earth. "Rog, Columbus. This flyby will serve as a benchmark and double-check to see if anything's happened since deploying the safeguard ring. Have you initiated your diagnostics?"

Chu swung his gaze around the control center. Two of the crew manning the seismographs, radiation detectors, and the rest of the monitoring equipment gave a thumbs-up. Chu said, "All diagnostics seem to be working."

Seconds passed. Albert Fukumitsu, the Earthbound Mission Control supervisor, responded on the audio-only channel. "Very well, Columbus. We read you in at two minutes. Please switch to the javelin's IR display."

Chu stood stiffly. Jason could see how much he resented having Earthbound Mission Control directing his every action. *What ever happened to the Agency's all-important local command philosophy?* he thought. *That's what happens when the bean-counters get control.*

The holotank blinked, then displayed the image of the lunar surface speeding underneath the javelin's trajectory. The long fiber-composite projectile was still relatively high above the Moon's surface, broadcasting images up to the L-2 relay station where they were bounced toward Earth. Soon, the IR images would arrive in a super-high-resolution mode, enabling detailed playback as the javelin passed over the alien artifact.

Chu sidled up to Jason and Erika, speaking in a low tone outside the broadcast locus for Agency mission control. "Glad you could make it for the fireworks."

"Thanks."

Chu nodded to Erika. "It's going to be interesting to see how active your little nanotech machines have been, Dr. Trace. They could just march out and dismantle those warheads."

Jason saw her eyes widen at the reference to *her* nanomachines—as if the entire Daedalus construction were somehow her fault. He said, "I was just out there, Bernard. From what I could see, the artifact looks about finished."

Chu glanced to the holotank, then lowered his voice. "If that's true, then Celeste isn't going to wait terribly long to detonate those nukes."

Erika stared at the IR javelin's transmissions as she spoke. "We can't say for sure whether or not the construction is finished if we don't even know what it is."

"Thirty seconds," came the voice from the holotank.

Chu turned away, focusing his attention on the activity again. "Max magnification." He rubbed his hands together. "Enhance surface-temperature contrast. Use false-color imaging."

In the holotank, the ground below the javelin rushed by, a strange dark gray with patches of barely discernible light. Sudden splotches of primary colors burst in, showing subtle differences of the sun-washed regolith.

The crater lip appeared, roared behind them, then left the huge alien construction glistening in reflected sunlight, smeared by faint color changes of

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temperature fluctuations. But otherwise the structure remained at ambient temperature. The hot zone that had previously been glowing in intense colors from the nanocritters' waste heat, now slumbered in the same gray calibrated to the average dayside lunar temperature.

The dipole antennas of the Very Low Frequency array appeared on the floor of the crater as the javelin continued its flight. A good fifteen seconds passed before the holotank turned fuzzy white on gray as the signal went dead. "Gone," said Newellen.

From Mission Control, Fukumitsu's voice said, "Looks like we didn't get good data on that one, Columbus. Malfunction in the IR instruments?"

Chu frowned and spoke to the crew in the rear of the control center. "How does the javelin check out?"

"Infrared instruments functioning normally."

"OK." Chu fell silent, then turned and searched the room. "Newellen, get on the playback controls and try the backup camera. Run back those last fifteen seconds—pump it as low out of the visible as you can."

"Right." Newellen waddled over to the side and slid behind the panel. "I think I can squeeze near IR out of that filter."

A minute later they watched the ghostly image of the Daedalus artifact, fuzzed out by the hampered resolution of infrared in the blazing sunlight. The alien structure showed no temperature differential from the surrounding regolith.

"Well I'll be dipped," Newellen said. He twisted around in his chair. "Ambient temperature. If I didn't know better, I'd say the artifact is stone cold."

"What's going on?" Jason asked. "How could the nanomachines stop radiating heat? Is it something in response to our planting the defensive ring?"

"No," Erika said. Her green-brown eyes had widened and her voice dropped to an awed whisper. "It means they've stopped. All of the nanocritters. They've shut down."

"What are you talking about?"

"No more activity. They switched themselves off." She turned to the image on Newellen's holotank. "And that means they must be finished! The structure at Daedalus is completed. Whatever it is."

Albert Fukumitsu's voice broke in from Earth, agitated. "Columbus, what the hell is going on up there? Should I contact Director McConnell?"

Chu waved a hand behind him. "Turn those clowns off so I can think."

Newellen grinned and spoke into the link, "Ah, having some trouble up here, Mission Control. We'll have to dead-start the link." He switched off communications with Earth.

Chu stepped up to the holotank. He stared at it for a long time. "Launch another one of Newellen's supercameras. I want to see the regolith close up. If the nanomachines have indeed shut down, then the camera will keep broadcasting images." He scratched his dark hair. "This way we can see exactly what those aliens are up to over there."

Three cubes displayed test-pattern images from the incoming supercamera; tags identifying them as IR, VISIBLE, and UV glowed beneath each of the respec-

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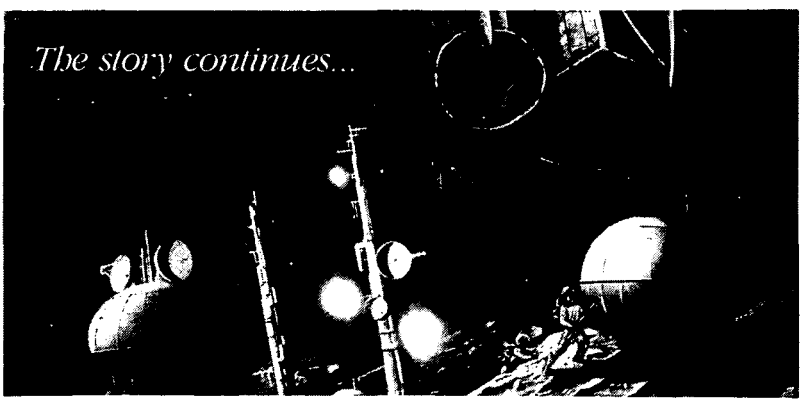
The pod's instrument panel measured his movement toward the Amnion warship like a countdown to death. According to the screens, he now had six more hours to live... to figure out who was being betrayed by whom.



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tive cubes. After a splash of static as the images reassessed themselves, they began to show high-resolution micrographs of regolith grains. Nothing else.

The camera's sampling end had penetrated several meters into the regolith; it should have been swarming with the nanomachines that had taken apart Waite, his companions, and their hopper. Instead, they saw only regolith.

The view from the probe's upper stereochips looked out over the crater from a canted angle. The glistening alien structure stood waiting.

"But why now?" Chu swung around in his chair. "It doesn't make any sense."

Newellen sat up straighter. "Do you think they might have caught on that we're going to blow the hell out of them? Maybe they're holding their breath to see what we'll do. Maybe they're massing right now to take out the nukes."

Salito snorted. "They would have shown up in the IR."

"It had to happen," Erika said. "When they're finished with the preprogrammed construction, they would have to shut off."

Again, silence. The images in the holotank hadn't changed. If anything, the IR cube had grown darker, less patchy.

"It's been one minute." announced Newellen.

Erika moved away from Jason and approached the holotank. She stood next to Chu and with her finger followed the outline of the distant structure in the holotank.

Jason watched her for a moment, then said, "OK, what now?"

"Cut it," said Chu. "We'd better decide fast what we should do—otherwise the Agency is going to make up our minds for us. They'll get spooked and push the button."

Erika's voice came out stronger than the murmuring comments in the control center. "There's something we have to do. Something we can finally do. It's been impossible before."

Jason saw that all eyes in the control center had turned to her. Even Bernard Chu watched her with eyebrows raised, waiting.

Erika spoke as if she were saying the most obvious thing in the world. "We have to go out there in person. We can finally see what this thing really is."

CHAPTER 26

Washington, D.C.

Celeste woke up screaming.

She couldn't breathe. The sweat-drenched sheets tangled around her like ghostly assailants trying to hold her down and rape her.

Chuck and Yeager leaped off the bed and started barking, as if to protect her from some unseen threat. The bed rocked as they sniffed and placed their paws on the mattress, craning their heads to find the enemy that had somehow come into the house without them noticing.

Beside Celeste, Simon Pritchard sat up wide-eyed and blinking. He couldn't seem to form words after his startled awakening. Instead, he wrapped his arms around her, pulling her against him. "Shhh," he said.

Celeste shivered, fighting back the visions clamoring out of her subconscious. She nestled back against Pritchard's chest, feeling the warmth of his

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body, the press of his skin, the strength of his arms as he held onto her.

Her nightmare was like a shadow of something terrible unleashed across the Earth, so great that it would swallow up the stars. Another facet of the dream, bright light and blinding cold. Someone had let the demon out of the bottle, or someone would. Celeste felt tiny and weak, smothered by the dreaded foreknowledge.

She had no idea how she could stop something so immense.

"It's OK," Pritchard whispered in her ear. He gripped her arms, kissed the back of her shoulder.

She couldn't drive the blackness of terror from her mind. Her heart pounded, trying to catch up to her panic. She knew her breathing had stopped during the vision—she had barely survived the nightmare.

She squirmed out of Pritchard's grasp, reluctant to leave his encircling arms but needing something to wash down the screams in her throat. Trembling, she gulped some lukewarm water from the glass on the bedside table.

Beside the bed, the black lab and the German shepherd both whined, looking at her anxiously to make certain everything was all right. Celeste squeezed her eyes shut to stop another gush of panic. No, it wouldn't be all right. Nothing would ever be all right again.

Unless she could do something to stop it. She had failed many times to interpret her dreams correctly—but she had succeeded with the *Grissom*. This time, she must get it right.

Tears stung her eyes, but she blinked them away, keeping her back turned to Pritchard. He remained sitting behind her, baffled and helpless, unaware of what she needed him to do.

Reaching out, she let the two dogs lick her fingers, reassuring them. Her gut-level reaction kept telling her to run. But Celeste McConnell, director of the United Space Agency, could not surrender without a fight. Her rare moments of peace shattered so quickly, so easily.

She and Simon Pritchard had intended to have a few quiet hours to themselves after weeks of unrelenting scrutiny and too little sleep. They had enjoyed a quick candlelight dinner of take-out barbecue ribs and cole slaw, eaten in the screened-in porch of her house. When she had excused herself and returned a few moments later wearing a new glittersilk negligee, Pritchard had laughed before standing up to wrap his arms around her, pushing his hips against hers.

When they made love on the floor, listening to the hum of thousands of insects outside, Celeste could taste the spicy barbecue sauce on Pritchard's lips.

Afterward, lethargic, she had shut off all the household communication systems before leading Pritchard to the bedroom. Just to get some peace, some much-needed sleep. The two of them deserved that much of an escape. They had kissed for a while, holding each other's sweat-slick bodies in the humid air before drifting off to quiet dreams.

And nightmares. A thousand times worse than the *Grissom* dream, worse than her feelings of dread when an accident was about to happen. Whatever was now unfolding would shake the entire world.

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Pritchard tried to comfort her again. He squeezed her shoulders, massaging her neck and her back. Normally, she would have purred with contentment at his touch, but now the muscles felt as if they might snap rather than relax. She had not turned to look at him in nearly a full minute.

"It's OK," he said again. "It's just a nightmare."

"No," she said in a brittle voice. Pritchard did not understand nor would he. How could she ever explain her dreams? "No, it isn't 'just' a nightmare, Simon. Never 'just' a nightmare."

Without waiting for him to respond, Celeste went into the living room. The fireplace sat black and cold. In the screened-in porch, the table where they had eaten lay strewn with smeared napkins.

On the main screen in the den, an insistent red message light flashed. Though it did not surprise her, seeing the light filled her with dread. This was it. Last time, the communication had been Bernard Chu telling her of the contamination on the *Collins*. This time the nightmare had been infinitely worse.

She heard the rustle of a robe as Pritchard came up behind her, still perplexed. With him there, she spoke to the receiver. "Play message." She felt her anxiety surge as the image formed.

Albert Fukumitsu, the manager of local Mission Control, stared out at her, appearing both exhausted and annoyed. His black hair looked even shaggier than usual. He sighed and pursed his lips in a frown before speaking. "Director McConnell, I wish I could find you. I've tried your office, your vehicle phone, now home." He sighed.

"I hope you get my messages. You really should be here." Behind him several technicians in the nerve center were busy, more agitated than they should have been at such a dead hour. She could see space-suited figures on the holoscreens in the background, but she knew of no special EVA activities on the schedule.

"The alien nanomachines at Daedalus site have shut down. All at once. Whatever that alien construction is, it must be completed, ready to go. Jason Dvorak and Erika Trace have taken Columbus's last hopper over there. You really should be here, Director McConnell. The whole world is watching. Please get in touch with me as soon as possible." He signed off.

In the dim room, Celeste stood naked and shivering. Everything had gone cold within her body. Outside, in the thick forests overlooking the Potomac, she could hear the buzzing of insects, who seemed to be whispering to each other about the impending end of the world.

The two dogs paced the den, bumping her legs in an effort to get a casual pat from her. Celeste felt sick with fear. The pieces were starting to fall into place.

The Daedalus construction was complete. Any moment now it would fulfill its purpose—or Dvorak and Trace would trigger something. Either way, all of humanity was threatened.

"This is fantastic," Pritchard said, startling her. She turned and saw his eyes wide with childlike wonder. "Now we can finally see what's out there."

For a moment, Celeste wanted to

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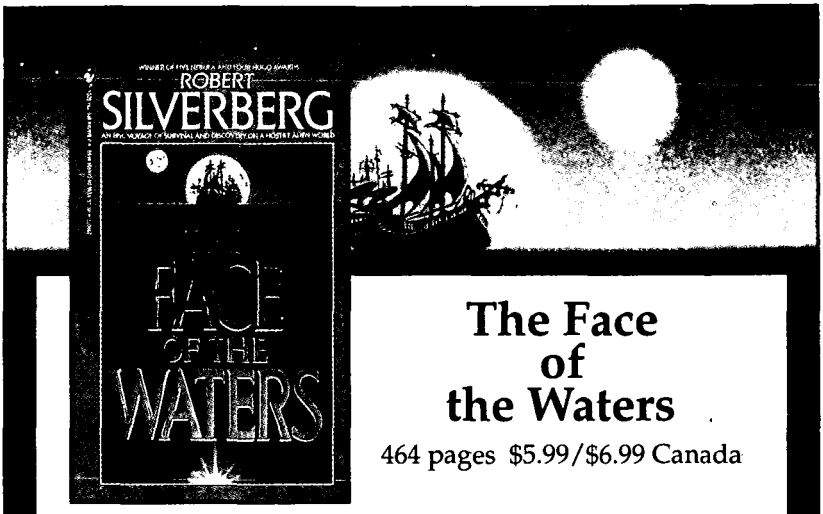

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scream at him for being so stupid. How could he express delight and curiosity when the construction might be a planetary-sized weapon that could crack Earth open to the core? She controlled herself and martialed her thoughts. If she was going to have a chance at saving humanity, she would have to call on every scrap of ability she possessed.

"Simon," she said, turning to him, "this is a crisis. I need you now more than ever. Get dressed. You'd better make it your dress uniform. The whole world is watching, as Albert said. We have to make this good." She checked the time of Fukumitsu's message and glanced at the chronometer on the wall. "Damn it all to hell! Why couldn't I have more time?"

She glared at Pritchard who still stood in his robe, wide awake but stunned. "Simon!" She hustled him back to the bedroom, to his clothes. "We've got to stop them before they destroy all of us!"

CHAPTER 27

Daedalus Crater

"You two going to be all right staying in the hopper?" Jason finished checking the chest panel of his space suit. He flexed his gloves before looking up to Bryan Zimmerman and Cyndi Salito by the cramped controls.

"Give me a break," grinned Cyndi. "Right, Zed?"

Zimmerman grunted. He didn't appear interested in anything except disabling the Agency's coded radio links with the nuclear weapons encircling the crater. He tried to key in a hack that would scramble the detonation sequence.

As they looked at the towering alien superstructures, Jason felt like kicking himself for agreeing to place the ring of warheads—it had seemed like a safe option at the time, a comforting defense against the unknown. But now he and three others were sitting ducks if someone back on Earth got itchy fingers.

Not to mention the threat from the supposedly dormant nanomachines inside the hot zone. They were about to go trudging across the regolith where Waite, Snow, and Lasserman had gotten chewed to pieces.

The hopper's IR sensors were hooked up to alarms designed to yammer like crazy if they detected any telltale waste heat indicating a surge in nanotech activity. Inside the helmets, Bitchin' Betsy chips would squawk at them to get out of there.

Jason glanced at Erika. "About ready to go?"

She smoothed back the head cap that held her sandy hair out of her eyes. "Time's a'wasting." She turned to the hopper's airlock. "You're holding up my Nobel Prize."

Jason picked up his helmet to follow her. "We'll keep in contact, Cyndi. Hey Zed, any luck with the links to the nukes?"

"Not yet," Zimmerman said. "They're pretty damn safeguarded."

Jason tried to squelch his panic. "Keep trying. If there's any way you can cripple the detonation links—"

"He's trying the best he can," said Cyndi. "We've got just as much incentive to stop those things from going off." She leaned over and kissed Jason on the cheek. "Be careful out there." She spoke softly and threw a glance at

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Erika. "And take care of her, too. She's good for you."

"Thanks." Was his attraction to Erika so obvious? Of course it was.

After sealing his helmet, Jason squeezed into the airlock with Erika. When the pressure began to drop, his suit stiffened as the trapped air redistributed itself to push against the vacuum like a thousand tiny palms.

Emerging from the hopper, they climbed down the ladder. Stars burned in the lunar sky, though it was Farside's daytime. As soon as they touched the crumbly ground, Jason could see the fine dust kicked up by their landing. Outcroppings of lava rocks were draped on the crater wall, highlighting the access road Waite had taken in his rover before anyone had known of the alien construction. In the distance, sprawled across the flat pan of the crater like a madman's twisted glass sculpture, the Daedalus artifact stood out against the backdrop of space.

Knock knock. Anybody home?

Jason bumped his chin mike and spoke to Erika. "Get as many pictures as you can with the additional stereochips. Keep them interested Earthside."

Erika finished taking a panoramic shot of Daedalus crater and the disassembled portion of the VLF array. The gaping pit beneath the giant weblike struts looked bottomless.

Beside the hopper, the inflatable lunar rover unfolded and swelled to size. Jason scanned the rover's controls as his own breathing echoed inside his helmet. He was reminded of snorkeling on the reefs in Hawaii. Only this time there wouldn't be pretty fish to see—only dormant Disassemblers ready to switch to new, more destructive programming.

Three video screens with touch-driven menus took up most of the control panel. Powering every system on, Jason brought up the forward-looking IR sensor as well as the surface-scanning radar to warn of obstacles washed out by the glare of sunlight.

On another display screen he brought up a digitized map of the construction. The whole crater had been well mapped out by now, watched almost daily as the alien complex grew in size. Inside the hot zone plunged a deep pit from which rose the main arches of the structure. Low-slung objects that resembled buildings lay all around the edge. Nine causeways—roads?—connected the buildings to the area outside the hole.

With his eyes on the map, Jason traced a path to the pit, then to an access way that might allow them to enter the complex. The printout gave a running estimate of the probable material strength of the construction. Nanomachines locking crystals together one molecule at a time, could create substances with enormously greater flexibility and strength than even the best zero-g materials Jason himself had used in his Earthbound architectural designs.

"Well, are we gonna get going?" Erika asked.

Jason stopped reviewing the map. "Right now." He brought the rover up to its maximum speed. They approached the Daedalus artifact.

Cyndi's voice came over the radio. "You'll hit the hot zone in about seventy seconds."

"Former hot zone," Jason corrected.

Erika broke in, "Still no activity?"

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"You'd be the first to know," said Cyndi. She clicked her mike.

"Thanks," said Jason. Behind her unreflectorized faceplate Erika looked scared, but amazed to be setting foot in the place she had studied for so long.

Jason kept his attention riveted to the blasted ground in front of him. The crater floor was smooth, and even at the rover's speed, there was little jarring. Ahead of them, uncountable millions of nanocritters had been swarming only hours ago. He hoped they would remain sleeping. The image of Trevor Waite dissolving kept replaying itself in his mind.

He glanced at the IR scope in front of him and saw no activity. Newellen's supercamera was still transmitting in perfect health. As they trundled along the access road, the radar scan showed no obstacles bigger than five centimeters—except for the artifact.

"Ten seconds."

Jason looked to Erika. She stared straight ahead, intently watching the alien artifact grow closer.

Cyndi said, "Congratulations, guys. Let me be the first to welcome you to nanotech neighborhood. Please keep your seat belts fastened until the Moon has come to a full and complete stop."

"Dr. Salito, please restrain your sense of humor," Bernard Chu's voice broke in through the suit radio, reminding them that all of the moonbase, and Agency Mission Control too, were watching every move they made.

"Roger, sir," clicked Cyndi.

Oh well, Jason thought. *This isn't supposed to be fun anyway.* Another minute or so and they would be at the rim of the pit. Jason clenched the steering controls, ignoring how the gloves bit into his fingers.

Cyndi's voice came over the radio. "Careful you don't go flying over the edge, Jase. No safety rails, you know."

Jason pulled back on the throttle and paid more attention to the radar images on the flatscreen. The rover slowed to a more reasonable fifteen klicks. Jason decided to get in as much sightseeing as he could—this was one of the biggest firsts in the history of humankind.

The radar screen turned black at the edge, showing the rim of the nanocritter-excavated hole. Jason looked out over the horizon, and suddenly the hole grew enormous in front of them.

"That came up pretty fast," said Erika.

"I keep forgetting about how close the Moon's horizon is. And that's one big mother of a hole!" Jason looked down at the computerized map, then across the flat plain of Daedalus. "We might as well cut across, use those bridges if they'll hold us. We'll reach the access roads faster than trying to go around the circumference of the hole."

"Go ahead," said Erika. "I'm trying to get in as many shots as I can." She kept scanning the artifact. "Stop when you get to the access way. I want to drop off a package of instruments for Big Daddy and a portable relay dish."

Jason concentrated on getting the rover safely to the access way, alternately using his computerized map, radar, and line-of-sight to guide him along the deep pit. All around them rose the solid arches, like gossamer confections stronger than steel.

The support struts and the main walls of the structure rose cleanly out of the

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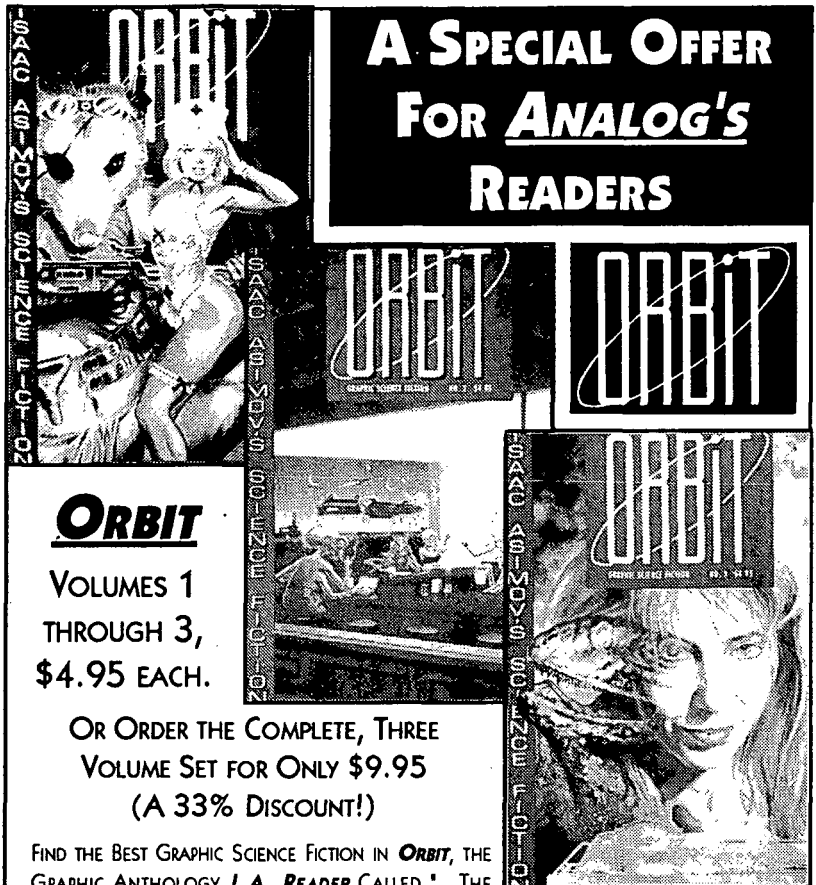

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regolith, with no footprints, no signs of disturbance. Even though he knew the nanocritters were responsible for the assembly, he still felt shivers looking at the tall, milky structure.

Bernard Chu's voice broke in. "Please give us a running account, Dr. Trace, Mr. Dvorak. We can't see all the details from the visuals you're sending us."

Erika cleared her throat. "Jason is approaching the edge of the pit now, directly next to one of nine causeways that extends to a complex of secondary structures that surround the lobed construction in the middle."

Jason anchored the rover with the emergency brake. He turned to Erika. "Well, should we get out and look?"

The two of them dismounted from the low vehicle and cautiously stepped toward the edge of the sheer pit. Behind them, they left footprints on the regolith that seemed glaringly obvious on the otherwise untouched crater floor.

The giant dish structure lay before him not half a mile away, like a glass water lily hundreds of meters high. The diamond-thread arches came up from the hole to a point at the base of the petals. On either side of the path leading to the antenna, the hole dropped off into deep blackness, where even the Sun's unfiltered rays could not penetrate.

"This is simply incredible," Jason said, shining his lamp down into the dark. "We've found the network of catacombs. No telling how deep or how far they go. As ambitious as those nanocritters were, the Moon could be Swiss cheese all the way to the center." He turned to Erika. "Getting a close-up of this?"

Erika finished setting up a package of instruments on the ground next to the rover. "I've got the magnification up high, but there may not be enough contrast. Kind of hard to focus."

Jason stepped forward to touch one of the towering milky-glass pillars. Not long before, every molecule here had been assembled by swarming nanocritters. He hesitated only a moment before he stroked the smooth surface. "Columbus, looks like everything in the alien complex is made up of long, unbroken fibers. Primary structural elements are all wound together, and each winding is surrounded by another winding, making a bigger winding, and so on up the hierarchy." He shook his head. "Far away, it looks smooth, but not up close."

Seconds later, words bounced from Mission Control on Earth came to them. Jason recognized the voice of Albert Fukumitsu. "All our channels are open and active. We're recording everything here. No way are we going to lose any of this. And by the way, we've just got an accurate measurement of the diameter of that hole from Erika's sounder—it's 2.99944 kilometers." The excitement in Fukumitsu's voice made Jason breathe a little easier. Nobody was going to push the nuclear button right now at least.

Jason felt pressure on his arm, Erika tugging him onward. After the two of them climbed back into the rover, he turned the vehicle toward the pathway that arched across the seemingly bottomless pit. He took a deep breath. "Columbus, we're moving onto the causeway. Approaching with extreme caution. Seems sturdy enough."

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"Roger."

Under the starry black sky Jason couldn't make out the other eight symmetrical pathways that he remembered from the maps. The unsupported path was a good five meters wide, rising up in a steep fifteen degree slope to a point halfway across the chasm before coming back down onto the main complex.

With the foreshortened perspective, it looked like only a hundred meters to the other side, but as Jason started driving across, the distance seemed to get longer.

He kept his attention on the rover while Erika continued her commentary. "The causeway—a bridge, really—seems to be comprised of the same twisted fibers that make up the arches. There is one large bundle I can make out, along with finer and finer strands down as far as I can see."

The steep slope of the glassy bridge made Jason feel like they were about to fall to the side, ready to plunge into the pit. But the rover tires held, and he maintained a meter of clearance on each side.

Jason peered over the edge, unable to see the bottom. It seemed to go on forever. "How are we ever going to find out how deep this guy goes?" The depths had not reflected any of the electromagnetic signals sent out by the javelins.

Erika shifted in her seat. "My EM sounder isn't giving a reading. Somebody would have to go down there, I guess."

They rolled to the top of the cleanly rounded summit and paused to survey their dizzying position before beginning to roll down the slope to the other side of the pit. In another few minutes they would reach the complex.

Jason felt a drop of sweat work its way down his back, seeping through the tight inner garment he wore.

Ahead of the rover, the Daedalus construction looked enormous. The glassy pathway sloped down to one of the secondary structures. The "roof" was flat and approximately square. He couldn't judge distance, but it had to be a hundred meters on a side. And this was one of the smaller buildings!

The overhanging translucent petals of the kilometer-wide dish sprawled over them, blocking out the stars and casting blurred shadows on the floor of the crater. On the flat rooftop of the secondary structure, Jason eased the rover to a halt.

Erika pulled another instrument package from the rear compartment and stepped out. She placed her bulky boot gingerly on the structure's roof. She set her package down, then brushed her gloved fingers over the construction material. "I can't tell what it's made of, but it's unyielding."

On sudden impulse, Jason rummaged through the emergency toolbox, and withdrew a long bar meant to be used as a lever. "Erika, get a picture of this." He placed a foot on the building, took a swing and hit the alien material with the bar. His own inertia lifted him up into the air, then practically tossed him flat on his back. The bar recoiled violently, hurting his hands.

"It's solid all right," he said. "I can feel this bar vibrating like crazy."

With a crackle of static, Newellen's voice came to them, relayed from L-2. "Let's just hope nothing comes out of

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the door now that you've knocked."

Erika turned back to the instrument package. "I don't detect any motion that might point to heavy machinery inside." She paused. "I did pick up your hit, though."

Jason said, "Let's keep going then. Look at all these access paths. There has to be a way to get inside."

"Follow the nano-brick road," said Erika.

"Very funny." He drove on. He watched the base of the antenna construction approach as the rover crept over the top of the secondary structure. As an architect, everything he saw amazed him. He wondered what his old hero Eiffel would have thought about all this.

"It occurs to me that we haven't seen any type of ground support for this thing."

"Aren't those diamond arches holding up the petals?"

"Yeah, but how are *they* being held up? And what about this building we're driving on? Where's its base? The only visible means of support are these pathways extending over the hole."

Jason kept his eyes straight ahead and his hands on the wheel. "We're looking at something truly alien, designed by minds that didn't develop architecture the same way humans did. I mean, even on our own planet, different cultures developed different ways of accomplishing the same tasks. Look at the pyramids of Egypt and then in Central America. The Mayans never developed the arch—they used trapezoids instead of squares. Who knows what a completely alien brain on a completely alien planet could have cooked up?"

He paused to ponder longer. "If this whole thing is being supported by just those pathways—my God, the entire structure could be 'floating' suspended in this gigantic hole. And how far down does it go into the pit—miles?"

The base of the giant flower was a hundred meters away. The diamond arches gathered at a point at the base, keeping the huge dish off the surface of the building.

Erika indicated a point just under the arches. "I see a bulge on the surface, where everything converges. Maybe it's an access port, some kind of doorway."

Jason turned to look at the base. The thing looked impossibly delicate—too elegant—to have been constructed on Earth, or even conceived by a human mind.

He whispered, "Suppose this whole construction wasn't meant to stay in place? If it's floating, then maybe this is some sort of spaceship . . . maybe this wasn't meant to remain here, but go on to Earth?"

CHAPTER 28

Washington, D.C.—Local Mission Control

Simon Pritchard held onto the passenger side of the car as Celeste drove at breakneck speed toward Washington, D.C. They wound down the narrow lanes from her home on the Potomac, sliding on fallen leaves dampened by dew, then got onto the George Washington turnpike.

Pritchard did not dare say a word. The street lamps flashed across her face like strobe lights. She increased speed. Pritchard's feet kept pushing an imaginary brake pedal on the passenger-side

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floor.

Glaring headlights from late-night drivers splashed across their view. Celeste wheeled along the road, going around anyone in her way. Exit signs flashed by, unread. They both knew the way to Mission Control.

By the time Celeste reached Agency headquarters, Pritchard had grown numb with uneasiness. Something had terrified Celeste, and he could not get her to talk about it. But he saw how much it disturbed her. She parked, and Pritchard squeezed her arm to show his support, whatever she might need. By now he had learned not to ask questions.

She gave him a distracted mumble of acknowledgment and got out of the car, motioning him to do the same. She ran up the walk, up the wide syn-granite steps, and Pritchard hurried after her, stiff in his confining dress shirt.

Pulling the glass doors open, Celeste darted past the two outer perimeter guards, waving her badge but not giving them time to inspect it. The guards stood up, startled, intent on watching their own screens of Mission Control, where something important seemed to be happening.

Celeste ranged ahead of him down the halls, and Pritchard walked briskly to catch up. She paused for him at the access doors of Mission Control, then pulled open the alarmed gate, slipping her ID card into the reader as they both crammed inside. As soon as the outer gate closed, the inner door unlocked, and they squeezed out of the booth into the bustling control center.

By this time Celeste was so out of breath that she could not even speak. Pritchard felt his heart pounding as he steadied himself against the wall. Adrenaline gushed through his bloodstream, and he made ready to help in any way, though he still did not understand what was going on.

Some of the technicians turned to look at their arrival, but the others remained enraptured by what they saw on the screens, even the two armed guards standing by the entry, a Japanese man and woman. The head of Mission Control, Albert Fukumitsu, was too wrapped up in the events to give them more than a cursory glance. A hush blanketed the whole room.

On the big holoscreens, Jason Dvorak and Erika Trace were exploring the alien artifact.

Celeste panted and tried several times before she finally managed to push words out of her throat. "Mission Control internal cameras off!"

Albert Fukumitsu turned to her, ready to mouth "Why?" but she snapped, "Cameras off! This is a security matter!" Celeste had grown livid. It frightened Pritchard to see her this way, transformed into a stranger by her unexplained terror.

The techs looked at her with stunned expressions, as if too many things had happened in too short a time. Several turned to Fukumitsu for guidance. One reached across to an unoccupied console and keyed in a command string. The tiny red lamps above the implanted videocameras on the wall winked out.

"OK, cameras are off," the tech said.

Fukumitsu strode over, wearing bell-bottom jeans that had already gone out of style for the second time. He wore a harried, concerned look. "You got one

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of my messages, Ms. McConnell? They've been at the Daedalus site now for about half an hour. Do you need a full report?"

"Get them out of there!" she shouted. "We don't have much time!"

Pritchard narrowed his eyes. Fukumitsu squinted at her as if to check her identity. "It appeared safe. They volunteered. I thought you would want someone to explore—"

"Get them out! You don't understand what they're going to cause! We're all in very grave danger!" Her black eyes glistened.

Pritchard stepped forward to support her, as he had mentally promised to do. "Please listen to the director, Mr. Fukumitsu. Order those people to return to Columbus immediately."

Fukumitsu froze for a moment, and Pritchard could sense the wheels turning inside his mind. The head of Mission Control chose to be passive. He shrugged helplessly. "These are images being transmitted from atop Dr. Salito's hopper, taken from long distance. We can't communicate directly with Mr. Dvorak or Dr. Trace—Dr. Chu has complete operational control from Columbus, so Trace and Dvorak are cut off." He shrugged a second time.

"Get hold of Chu then!"

Fukumitsu spoke slowly, "Every newsnet in the world is picking up these transmissions. You can't cut them off . . . like you just did to us."

Celeste looked at Pritchard, then pressed her palms to her temples. She appeared much older than he had ever seen her. Her black irises looked as deep as the pit on Daedalus. Her desperation began to rub off on Pritchard.

"Then we're going to have to take some drastic measures," she said. Her voice sounded very cold. "Right now. We may only have a few minutes left."

Pritchard sensed the situation was careening out of control. He hesitated for a moment, then decided to get one more piece of leverage. He strode over to the pair of Japanese guards, walking straight.

He chose the closest guard, the one who looked more uncertain. If these two were anything like the Agency security in the outside lobby, his task would be simple. "Sergeant, please hand me your sidearm. Now."

Confused, the man hesitated.

"Sergeant, do you hear me?"

The female guard intervened. "I am sorry, sir. We cannot surrender our weapons without proper authorization."

Pritchard raised his voice, knowing that everyone's attention was now fixed on him. Thank God Celeste had thought to shut down the cameras. "Do you see these?" He pointed to the two stars on his right shoulder. "I am the top of your chain of command! What more authorization do you need?"

Then he lowered his voice. "This is a crisis situation, Sergeant. You are supposed to follow orders, particularly now. Can't you see that world-shattering events are taking place here? You—" He turned to the woman guard who had interrupted him, "may keep your own weapon as my backup."

He returned his attention to the first guard. "Your sidearm! Now!"

Reluctantly, the man handed over his service revolver. Pritchard took the weapon, trying to hide his own over-

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whelming tension. He wondered if he looked sufficiently threatening.

"So what do we do now?" one of the technicians muttered. Albert Fukumitsu shuffled his feet and stared at the floor. His lips moved, as if he were holding back a dozen different outbursts.

Celeste looked at the pistol in Pritchard's hand, and her shoulders slumped with relief. Her expression changed from inner terror to determination. He saw her swallow hard.

On the big stereoscreen, the images of Jason Dvorak and Erika Trace shuffled forward in a dream walk. They started their descent into the alien pit.

Pritchard prayed to God that Celeste knew what she was doing.

CHAPTER 29

The Daedalus Construction

"It's an entrance."

Jason looked down the ramp that descended into the secondary structure. The corners of the arches were delicate and rounded, highly elongated. Each detail added to his guess of what the alien "builders" must have looked like. "How big is it?"

Plodding in her cumbersome suit, Erika circled the ramp, taking measurements of the yawning hole with the electromagnetic sounder. "About three meters in diameter—big enough to take the rover down. How about a Sunday drive?"

Jason craned his neck and looked around. The ramp was set into the top of the building, directly beneath where the nine diamond-fiber arches came together at the base of the giant water-lily structure. He pulled the rover to where the ramp plunged under the lunar surface. Blackness swallowed the headlights. "That damned material makes it hard to see how far down it goes."

He flicked up both the radar and IR sensors. The IR showed heat radiating from inside, but not enough to let him see any features—and not enough to make him fear a nanocritter resurgence. The source of this warmth seemed to be something else entirely. "I guess the only thing to do is go down and see for ourselves."

"You're getting pretty cavalier, Jase. What about sending the rover down telerobotically?"

"We could have done that from the hopper." Erika still seemed skeptical, but Jason felt numbed by the grandeur around him. Somehow, he didn't think the "builders" would intentionally hurt them. "Where's your sense of adventure?"

Erika rummaged in the rover's cargo bin and pulled out a portable relay antenna. Setting the parabolic dish on the top of the building, she tried to find a place to anchor it, but the pneumatic punch had no effect on the alien material. She finally stretched out the tripod and eyeballed it to the L-2 point above.

"I want to keep everybody informed about what we're doing." She pulled out a winding of fine fiberoptic line, plugged it into the relay dish, and started unreeling it toward the ramp. "I've got a few kilometers of this stuff. At the very least, it'll help us not to get lost."

"Hansel and Gretel on the Moon?"

"Yeah. Ready to go?"

"Just a minute. Cyndi, you been following this?"

"Just be careful down there," came

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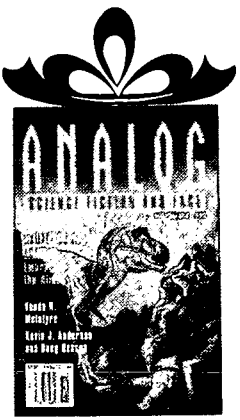

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Cyndi's voice.

Another cold shiver pulsed through him. It was a weird feeling, surrounded by a deserted alien complex as large as a small city. Craning his head back, he glanced up. A hundred meters overhead, the base of the kilometer-wide parabolic dish fused with the diamond-thread arches. This point seemed to be the central nexus for the whole complex. And the doorway led inside.

Jason swallowed and turned back to the rover. As he watched Erika smooth the loop of fiberoptics to reel out behind them, he spoke into his mike. "OK, Columbus—we're going in."

The ramp was steep, about a 15 percent slope. Jason had to bend backwards to keep from stumbling with the massive sensor package he carried. High above, near the opening, they had been forced to abandon the rover in the first tight turns of the catacombs.

Even worse, they almost turned back when Jason discovered they could transmit signals out through the fiber-optic connection, but they couldn't *receive* anything. Returning to the surface, they discussed the problem with Columbus.

"The cavity must be a one-way membrane for radio waves," Newellen conjectured. After a brief consultation, Chu had directed them to continuously transmit their journey via the fiber-optic link.

Erika used a cluster of lights to light the way along the sloping tunnel. The passage was tall and narrow and inclined to one side in a claustrophobic helical turn.

"Like a parking ramp in Augusta," said Erika. She directed the stereochip cameras in front of her, piping the signals out the optical fibers to the relay dish, hoping that Columbus could still pick it up.

Jason laughed. "I bet the Disney Corporation is already designing a new rover, complete with fiber-optics, so people can explore this place. Imagine the ticket prices."

"And the lines!"

Erika played her light up and down the walls of the corkscrew as they descended. The walls were black-speckled with a faint blue glow. The fibrous windings-within-windings continued to appear in the walls and floors. Otherwise, they saw no markings, warning signs, or even instructions.

"Your nanocritters aren't much for interior decorating," he said, trudging after her.

She hesitated. "Maybe they don't care about such things. We shouldn't assume the builders think like we do."

Jason quickly lost count of the turns as they descended. He had abandoned all sense of direction; his inner ear was useless to him. He saw only Erika's light in front of him as it splashed against the weirdly textured wall.

She captured everything on the stereochips. Beams pierced the darkness, showing the walls opening into wider passages. She shone her light around to the right. The corkscrew had stopped and was flush with the floor. "Looks like we've hit bottom," she said.

"Great." Jason placed the diagnostic package on the hard ground. He took care to lower the box by bending his knees. "This thing feels like it's gained weight."

Grunting in her unwieldy suit, Erika knelt in front of the package. Powering

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up the unit, she ran through a series of self-calibrations. "Stop breathing so hard, Jason. You're biasing the seismic sensors."

Jason took the light away from her and looked around, but most of the illumination was either absorbed or scattered by the alien material, reflecting barely enough for him to see in the large chamber.

Everything had a fuzzy-blue look to it, as if Jason could see the walls better without his illumination. He handed the light back to Erika. She knelt on one knee in front of the diagnostic package.

"Did you bump this against anything bringing it down here, Jase?" she asked. "You sure you didn't prang it against a wall?"

"No, why?"

Jason squinted at the box on the floor. LED readouts, touch-sensitive controls, and a few hard-switches made up most of the exterior control panel.

Erika straightened. "I'm getting an anomalous reading on some of the instruments. Really anomalous. UV photons are at a hundred watts per square meter—enough to give you a bad sunburn if you weren't in your suit. The second number is the neutrino flux. It's way too high."

Jason frowned. *Neutrinos?* They were notoriously difficult to capture in instruments, needing about a hundred *light-years* of lead to be sure of catching one; the new superconductor-based detectors were much better, but still not completely reliable. "Neutrino measurements aren't too accurate anyway," he said.

"We're not trying to be exact to a bunch of decimal points—look at that exponent! Five orders of magnitude higher than what we saw up top. The detector can't be that far off."

Erika pondered, then keyed in a query, moving clumsily with her gloved fingers. "It's about the flux of neutrinos you'd expect from a nuclear reactor."

He studied the perimeter of the chamber again, searching for telltale signs of any kind of machinery.

"No neutrons, though," Erika continued. "No charged particles. Nothing else except a UV flux." She stood up. "Don't ask me to figure it. Should we go on?"

"We don't know a damn bit more about the place," Jason said. He recalled sitting in front of his holo-dais, while Eiffel stared down at him. He had pondered the arches, the secondary structures, trying to infer something about the alien builders, a hint as to their mindset, their purpose, or their home world.

"Wait, maybe that UV flux does give us a little hint. What if it's their illumination? Maybe that's the alien equivalent of visible light, the frequency they see in. If their star is a UV radiator, then it makes sense."

Jason swung the lights behind them to where the complex opened up, deeper beneath the lunar surface. Handing the lights back to Erika, he picked up the massive diagnostic package with a grunt. "I feel like a pack mule." He followed Erika cautiously into the dark, not sure where they were going.

"Follow your nose," Erika said.

"Nothing else around here to navigate by."

With each footstep they took, the darkness opened up in an ever-ex-

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panding circle. Erika moved the illumination back and forth. Looking down, Jason could see only the indicator lights from the diagnostics package. The walls, the floor, the ceiling of the alien structure seemed to swallow up photons as they struck, leaving only the windings-within-windings material glowing a deep purple.

They trudged on in silence, growing more tense each moment, waiting for something to jump out at them. Every step Jason took seemed lighter than the last, which didn't make sense.

"This is weird, like one of those House of Mystery tourist traps with slanted floors and trapezoidal archways."

Erika finally pointed the beam to the ceiling. "That slopes up too. Everything is focused on where the corkscrew started."

The chamber kept getting larger around them. The downward slope increased again. Jason took two steps in front of her, as if he were walking into the mouth of something terrifying.

"Holy *shit!*" He felt himself starting to slip. His booted feet couldn't find a grip on the floor—because the floor was no longer there. It had suddenly lurched beneath him, dropping away like a funhouse gimmick. A surge of gravity grabbed at him. "I'm falling!"

He flailed his arms, trying to keep his balance; he pushed the diagnostic unit away from him. Every second seemed to take an eternity. Jason twisted his body as he fell, trying to prevent his helmet from cracking against the hard ground. All the time he kept his arms moving. The loose light twirled beside him, making crazy patterns as it spun through the vacuum.

He heard Erika's shouts, but couldn't make sense of them through his own yelling.

Even through the bulky padding of the suit and the slow-motion fall in low gravity, Jason felt the breath go out of him as he struck bottom. He had landed on his backpack; the heating and oxygen unit had softened the fall. He struggled to breathe, and only after the first sharp pain had gone away was he able to gasp for air. Sounds came over his radio, but they were distant, someone calling. . . .

His heart continued to beat fast. He tried to take slow breaths, to keep from hyperventilating. He didn't hear any telltale sounds of air hissing in his ears. Checking his life-system parameters with the heads-up display, he saw that his suit pressure was stable.

He heard a low moan. He struggled to an elbow. His backpack kept him from bending forward. Jason shoved hard with one hand and rolled to the front. Pushing up with both hands, he straightened. *You sure weren't meant to fall down in a bulky space suit*, he thought. "Erika?"

"Yeah." Her voice sounded weak. "Right here."

The light was off to the side, illuminating a distant wall. Jason stepped to the light, reaching out to ensure that he wouldn't hit anything. "You OK?"

"Yeah. I didn't even move, and I still came tumbling after you!" Her voice took a second to come back. "What happened?"

"Besides falling? I don't know." Jason bent to pick up the dropped light. He found Erika lying not far from where

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he had fallen. "How's your suit pressure?"

She took a minute to reply. "Steady." She reached behind herself. "And the optical fiber's still attached. Think we're still transmitting out?"

"We don't know if we ever were."

He stepped carefully to her. Walls of alien material rose up around them, glowing with the edge-of-vision blue color. He couldn't see how far they had fallen, or what had become of the hole they had walked through.

"Jase," Erika said. She had just finished struggling up from the ground. "Behind us. Is it my imagination, or is there a passageway back there?"

At first Jason could see only more of the alien material, then he caught a glimpse of something darker. "You're right." He turned the light back toward her. "How could you see that?"

"No blue glow. The light in your hand was blinding you."

Jason pondered that. "Let me try something. Stay still." He switched off the light. The entire chamber plunged into darkness.

It took a minute, but shortly Jason began to notice the faint outlines of several square entrances into the chamber. The squares were deep black, while the walls and floor around them glowed a bluish violet. He felt his eyes getting used to the darkness about as much as they ever would to the edge of the spectrum; to a different set of eyes, the chamber might be blazing with light.

"This place looks like a train station. I can count seven, no eight tunnels coming in here."

"Nine," corrected Erika. "Think about it—nine arches outside, nine pathways, now nine tunnels." Jason stood by and watched as Erika measured all the entrances to the tunnels, the chamber they were in.

"Sounds like they've got a thing for nines, or threes." Jason took another deep breath, felt his heartbeat slowing down. "Well, do we try to go back outside? Everybody must be worried about us. Or do we go on?"

"Go on, of course." He had never heard Erika sound so determined. "We might not get another chance to come out here if somebody blows it all up. All we've seen are tunnels so far. There's got to be something more."

Jason swallowed again, knowing she was right. "Then let's find it." He switched the brilliant light back on, breaking the spell. "So which way?"

"Your call," said Erika. "Pick a tunnel, any tunnel."

He hesitated for a moment, then struck out for the first corridor. He lifted the heavy diagnostic pack, hoping it would be worth their while to lug the thing along. They walked in silence on a level floor.

After many minutes of plodding, they stopped as Erika's light splashed on something large ahead of them. Jason could just discern the outline of a multifaceted building constructed of panels placed at odd angles. An architect's bad dream. The structure was a lighter color than the surrounding floor and walls; it appeared to be made from a different material. Some of the panels were adorned with an ordered array of circles parallel to each other, all pointing back down the tunnel.

Erika said, "What do you think?"

Jason wet his lips. The recirculated

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air in his suit seemed even drier than usual. "I don't know." He felt at a loss to communicate; this overwhelmed his sense of architectural insight. It looked as if an autistic child had tried to build something and had parts left over. Thin panels, wedges of material at every angle, a snapshot of a house of cards in mid-collapse. The structure didn't look as if it could support itself.

Erika started toward the exotic building. She kept the light trained on the structure, lighting up the panels covered with aligned circles. As Jason approached, the building seemed to rotate. It was all in the perspective, like walking through a painting. No matter where they viewed the structure, the circles pointed straight down the tunnel.

As if it were trying to tell them something.

CHAPTER 30

Moonbase Columbus

Big Daddy Newellen shifted behind the virtual display panel in the moonbase control center. It took him a moment before he could piece together enough words to speak out loud. Damned harebrained theory—but it all checked out. Everything.

Bernard Chu and the other crew members stared at the images transmitted back from Jason and Erika's exploration of Daedalus. At times, bursts of static interrupted the foreshortened images piped through the fiberoptic cable Erika had laid down, but they missed little.

An exterior view of the whole structure came from the hopper's cameras, sent by Cyndi Salito and Bryan Zed. At least those two were still in two-way touch, and antsy to do something. Three separate times, Salito had requested permission to go in after Jason and Erika, but Bernard Chu had flatly denied her.

Zimmerman had not been able to disarm the nukes in the fail-safe ring. Personally, Newellen couldn't imagine McConnell setting off the warheads now, not with people over at Daedalus—but Mission Control on Earth had fallen mysteriously silent, without even Fukumitsu's insistent questions. Chu had called it good riddance to distractions. But it made Newellen uneasy.

This new idea of his made him uneasier still.

"Hey Bernard, I've got to show you something."

Startled, Chu turned from the command podium. "What?"

Newellen gestured. "Come here. You're not going to believe me unless you see the calculations yourself."

Chu sighed and moved over to Newellen's station, keeping his gaze toward the holotank showing 2-D images transmitted by Jason and Erika. "Is it good news or bad?"

"Depends. Good, in the sense that I might have figured out a reason for a big part of that structure. Bad, in that it means all four of our people at Daedalus are in deep poop."

Chu's pinched face focused on Newellen now. "Tell me."

"Well, let's assume that that flowerlike main structure is some sort of wonky dish antenna. It has to have a purpose, and that seems likely. If it's to transmit E-M waves, then there has to be a way to get the electromagnetic energy to the antenna. Amateur electron-

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ics stuff."

"OK . . . " said Chu, "remember, I'm a biochemist."

"Basically, I've run some antenna design calculations and I think the passageway Jason and Erika are walking in is a mode converter. Giant size."

Newellen waited for some shocked reaction. Chu looked at him with a puzzled expression. "A what?"

Newellen sighed. "Mode convertors take electromagnetic energy in one spatial form and convert it to another. It's usually more efficient to produce E-M waves in one mode, but to actually transmit the signals they have to be converted to another mode, or pattern. I'm pretty sure from the measurements that those catacombs are mode converters."

"But what for?"

"It may be a way to phase-conjugate the waves, if they're coherent." He paused. "Our people might be walking through a giant radio amplifier. When you think about it, that one-way radio membrane makes sense: radio waves can only come out, not in. Since there are no incoming waves, it cuts down on losses in the cavity. It's a true diffraction-limited amplifier."

Chu grew alert, still not understanding but concerned. "And if it's turned on? While they're still inside?".

Ah, now the man was getting it! "Depending on the intensity, there's a good chance they might be cooked. The suits will protect them some—but radio frequency waves will still couple to the human body. It's not a very healthy place to stand."

Chu drew in a breath. He glanced around the control center, as if hoping for an inspiration.

Newellen kept stating his case. He felt suddenly hungry. "From what I can tell in the last batch of transmitted pictures, those circles on that gadget are some sort of solid-state devices, probably used for creating the E-M waves. It's a simple matter of phase-conjugating them—and the measurements work out." He shrugged. "But this is all theory, of course."

"Of course." Chu scowled, as if finally realizing that he wanted to pass this one off to Mission Control on Earth—but they had cut him off without any explanation. "Anything else I should know?"

Newellen worked his pudgy fingers along the controls, calling up another set of calculations. "Well, I was really puzzled by the energy source for this stuff. First, I thought, with the neutrino flux so high there might be some sort of fusion reactor inside. Neutrino detectors are quirky things, but they're not *that* bad. Erika's readings were a thousand times higher than they should have been for a fusion reactor, though. Outside the error bars by a mile."

Chu stared down at the stream of numbers, but they obviously didn't mean anything to him. "And?"

"The only energy source I know of that produces a neutrino flux so high is an antimatter-matter reactor."

Someone in the control center whistled. "Isn't that impossible?" said Chu.

"So are alien nanotech machines on the Moon," Newellen answered.

Chu swallowed and regained his composure. "So that device they've found is probably a matter-antimatter reactor?"

Newellen was suddenly struck by a

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thought. "And if each of those tunnels is supposed to act as a waveguide, then there must be eight more reactors just like this, one at the end of each tunnel. That signal's going to pack one hell of a punch when it goes."

Bernard Chu fidgeted, as if forcing himself to swallow something he found extremely unpalatable. "So Dvorak and Trace are sitting in the middle of a giant alien microwave oven."

"That's basically right." Newellen nodded. "And they don't even know it. Worse, since the nanocritters shut down and the complex is completed, that transmitter could go off at any time."

CHAPTER 31

Washington, D.C.—Local Mission Control

Major General Simon Pritchard felt his hand grow slick with sweat on the textured handle of the service revolver. Everything came to a stop as tension thickened the air.

In the Mission Control center, all attention flicked back and forth between himself, the transmitted images of Dvorak and Trace exploring the Daedalus catacombs, and Celeste in her barely controlled state of panic.

Petite and coiled to spring, Celeste turned her back on Albert Fukumitsu and marched toward one of the Mission Control flatscreen terminals. The tech sitting there swiveled in his chair as if poised to run.

"Punch up the command sequence for setting off the nuclear quarantine ring," she said. "I have the access codes. We've got no alternative but to detonate the warheads and end this once and for all."

Pritchard felt his skin crawl. He had been stupid not to realize what she intended to do, and now he didn't know which course to take. *How could he let her go through with this?* He trusted Celeste implicitly. Or did he?

Several of the techs leaped to their feet in outrage. "Wait a minute—" Fukumitsu cried. He sputtered before he finally found words. "On what basis do you make that decision? I've been here every second of the exploration and I've seen no evidence of a threat! Exactly the opposite—the aliens could have killed all the people on Columbus during the infection if they wanted to. They could have retaliated when Chu sent his home-made bomb. But they've made no aggressive move. None.

"Instead, look at what they've done—" He gestured to the screen where Dvorak and Trace stood inspecting the glimmering matter-antimatter reactor. "We still don't have a clue what any of this is. How can you just push the button—"

She shouted at him. "Because I *know!* I always know. That's how I knew about the *Grissom,* how I knew something bad was going to happen on the *Collins—*" Celeste caught herself before explaining any further. Pritchard furrowed his brow, trying to understand what she was implying.

Celeste lowered her voice. "You are out of line, Mr. Fukumitsu. It is not part of your job to question my orders. You are relieved, as of now."

Fukumitsu flinched as if he had been slapped in the face. But he refused to move. Celeste turned her anger instead to the tech by the console in front of her. "Punch up the command sequence,

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I said!'' She pushed him aside and crouched over the panel, working with the interface to pull up a set of menus.

Pritchard shifted the service revolver to his other hand, trying to keep himself motionless as the turmoil churned within him. What the hell was she doing? Now that more pieces were falling together, it made even less sense to him.

He remembered the night of Bernard Chu's communication from the *Collins*, how Celeste had wakened from a deep sleep full of nightmares. Then he recalled the uncanny story of how she alone had managed to rescue the people of the *Grissom* by somehow knowing to get them into the only safe place on the entire station. She had once told him how interested she would be in hearing about his dreams—had she been speaking literally?

Pritchard experienced the sudden, sinking certainty that Celeste McConnell, the powerful director of the United Space Agency, was making her major, often-questionable decisions on the basis of *dreams*.

Pritchard recalled making love to her earlier that night. Celeste seemed so desperate, clinging and grabbing at him. She had been full of erotic energy, wrapping herself around him like raw electric wires. Now, she wanted to use half a dozen warheads to blow up Daedalus and all traces of the alien artifact.

Perhaps she had been planning this all along. Because these were old-style warheads from a secure stockpile, they didn't retain all of the attendant checks and balances, bureaucratic stalling devices that would have made it impossible for anyone to set them off in a timely fashion if something disastrous did happen at the alien construction site.

Since the quarantine ring was not to be triggered anywhere on Earth, and on the opposite side of the Moon from Columbus, they had managed to ramrod approvals through, to streamline an emergency detonation process. Pritchard himself had helped.

The US president had one set of access codes, and so did the director of the United Space Agency. Celeste did have the power to detonate them—legitimately. In an emergency only.

But was this an emergency?

Prickles of sweat appeared on his forehead. Pritchard had not comprehended the magnitude of what they were doing. He had been swept along with his newfound glory, press conferences, important decisions that affected the whole world, sudden prestige for his lifelong work in a military that had fallen on weaker times. Somehow this did not seem to be the proper culmination of his life's work: to destroy mankind's first link with an advanced alien race . . . because of a bad dream.

On the screen, Dvorak and Trace moved deeper into the alien hall of wonders beneath the lunar surface. *There were supposed to be no people present when the warheads went off,* Pritchard thought. No risk to human life! But now two people had gone to explore, daring to do something no one else would do. And look at everything they had discovered. . . .

How could he let Celeste wipe that away because of a nightmare? A blot of mustard, a fragment of underdone potato, as Dickens would have said. And if she had only a vague feeling of impending disaster, how could Celeste

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know that she wouldn't cause the disaster herself? What if the nightmares were warning her of a completely unrelated threat? Even if her dreams were somehow truly prescient, how could he be sure Celeste was interpreting them correctly?

Then Prichard recalled seeing her sit up screaming in the middle of the night, sweat-drenched, with terror on her face. She did seem to know something. And she had been absolutely right about the *Grissom*. . . .

Hunched over the flat screen, Celeste called up the warhead command sequence. The technician stood beside her, his face the color of wallpaper paste. No one was willing to challenge the director's orders, especially not with Major General Pritchard standing there with the guard's service revolver ready.

"This is the only way. We'll be safe," Celeste kept whispering. "Trust me."

Rigid and formal, the second guard pulled her gun out of its holster. "I'm afraid I cannot allow you to do that, Director McConnell," she said. "Please step away from the console. Immediately."

Livid, Celeste whirled to glare at her. Her lips curled back. Pritchard thought for a moment she was going to hurl herself at the guard and try to wrestle the weapon away.

On the screen in front of Celeste, a schematic of Daedalus crater showed red circles at the locations of the deployed warheads. A blinking string of letters on the screen requested the access code, holding on a thirty-second time to detonation.

Pritchard pointed his own gun toward the guard, holding it steady. He did not let his own gaze waver. "Sergeant, please drop your weapon. Now."

The guard froze. She turned to meet Pritchard's gaze, but the major general could read nothing in her eyes. Would she shoot? How deep were her convictions? How deep were his own?

Pritchard cocked the pistol. "Drop it."

After a blistering pause, the guard set her gun down on the floor.

Celeste threw herself at the keyboard again and began entering the complicated access code that would trigger the ring of nuclear weapons.

In the holotanks, Dvorak and Trace stopped at a towering crystalline structure that pulsed with deep blue lights. Trace reached up to point at something.

Calmly, Simon Pritchard turned toward Celeste's console and pulled the trigger, aiming into the controls. Then he pulled the trigger a second time, and a third.

Glass, plastic, and metal shards flew into the air as the flat screen burst and the covering of the control panels shattered. Splinters of debris sprayed out, cutting Celeste's cheeks and arms as she staggered backward.

"No!" she screamed in frustration and despair. "Don't you understand?!" She glared at him in stunned fury.

Then, a low buzz came from the speakers, unnoticed for a moment with the echoes of gunshots. Within seconds, it built to a roar that screeched out on all wavelengths.

"It's coming in on every receiver!" Fukumitsu shouted.

The enormous signal continued to increase, deep and rumbling like a thun-

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derstorm in a bottle. Something of immense power had been transmitted from the great petals of the Daedalus complex.

"Blocking all channels!" one of the technicians shouted.

Pritchard wavered. On one of the wall holoscreens, he saw the image of the completed bowl of the Daedalus structure like a gigantic antenna. A transmitter. The enormous construction was designed to broadcast back to its creators and the whole Galaxy that it was finished. It was ready.

But ready for what?

"Like an all-clear signal," Pritchard whispered to himself. "Now all we've got to do is wait for a response."

Everyone fell silent in Mission Control. Pritchard found a seat and slumped into it. He flicked the gun's safety back on, and let the revolver drop to a shelf on one of the consoles. He closed his eyes. He did not want to have to look at Celeste. Not right now. He could not face her.

The air around him stank of burned gunpowder. He wondered if history would paint him as a hero or a traitor. It would all depend on how the aliens answered the call.

Celeste paid no attention to him. She had fallen to her knees on the floor, bleeding from a handful of minor cuts. She stared at the red on her hands. "Now it's too late," she said, over and over. "It's too late. . . . "

CHAPTER 32

Moonbase Columbus

Bernard Chu had blocked out the communication channel to Earth as the roar rumbled through the speakers in the control center. The technicians stood in their place.

"Get me Salito's hopper over on Farside! Now! Get a confirmation that Salito and Zimmerman are all right." He raised his voice to break through the chatter in the control center.

"Uh, Bernard—" Newellen said, trying to interrupt.

"I've got an answer from Salito!" one of the other techs said.

"Put her on! I want to know what just happened over at Daedalus!"

"Bernard," Newellen said again, more insistent, "that transmission didn't come from Farside. The L-2 relay is ringing as much as all our other instruments, but not from Daedalus."

"What are you talking about, Lon?"

Cyndi Salito's voice burst through the open channel. "Holy shit, Columbus, what was that!"

"Are you all right?" Chu demanded, turning back and forth as everyone shouted at him in the same moment.

"Sure—nothing happened here. Other than that transmission we heard."

"Bernard," Newellen interrupted. "I've got it pinpointed. That signal did not come from here at all. It's Mars! It was broadcast from Mars!"

Chu could not find words to respond as chilling thoughts winked into his mind. Of course, how could they have been so parochial? If, as Erika Trace and Jordan Parvu had suggested, the alien builders were indiscriminately beaming automata across the Galaxy, looking for any place to land and begin construction, how could they hit Earth's Moon and nothing else? Why wasn't Earth itself hit? The Daedalus construction must not be the only such alien

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monument being built in the Solar System, nor was it even the first completed.

The Daedalus nanomachines had been working double-time to repair the damage caused by his nitro and rocket-fuel bomb. It wouldn't be long before the Daedalus transmitter sent its own message. He thought of Newellen's comparison to a giant microwave oven—and then he wondered if Celeste was going to push the nuclear button after all.

He clapped his hands. "All right, listen up. Salito and Zimmerman, I want you to take off. Get away from the crater. Now! Get to a safe distance."

Salito broke in. "Ooops, something's happening here. Seismic sensor just started dancing."

"A Moonquake?" Bryan Zimmerman's voice crowded over hers.

"I think the antenna is moving!"

Chu scowled with impatience. "Cyndi and Zed, did you copy? Lift off, now. Safe distance."

The people in the control center milled around, staring at Chu. Finally, after a too-long pause, Salito's voice came back.

"Uh, we're not too keen on abandoning Erika and Jason inside there. We know they're still alive."

Chu crossed his thin arms over his chest. "Dr. Salito, if they are inside the radio cavity when a signal of that magnitude is broadcast, they will be fried by the radiant energy. If you are not shielded, you will also be killed. At the very least, all systems on your hopper will be shorted from the E-M interference. And we don't have another hopper to come rescue you. Do you understand me?"

Bryan Zed's voice remained flat. "Sir, don't you think we should go in after them?"

Dammit, Chu was getting tired of everyone trying to be a hero. "No! Four stupid deaths are worse than two. Get going. That's an order!"

"All right," Bryan Zed finally replied.

Moments later, when the hopper lifted off and turned its panoramic cameras down across the alien complex on Daedalus crater, they all watched as the huge glassy panels of the transmitter dish began to slowly swing around.

CHAPTER 33

The Daedalus Construction

Jason scanned the dim tunnels and the flashing, exotic structure embellished with the matrix of circles.

Then the fireworks started.

Ripples of blue light streamed along the tunnel walls, like annular waves of energy spewed from the strange machine. A flash of brighter intensity burst out, followed rapidly by a third.

"What's happening?" Erika whispered.

Jason stared. The first thought that came to his head seemed the most likely and the most frightening. "Powering up, I think."

The tunnels behind them held nothing, just conduits streaming to the surface, toward the gossamer bridges that connected the deep catacombs to the giant Daedalus antenna. It would take a long time for them to get back to the hopper, following Erika's fiber-optic thread—if they could even manage to get back up from where they had fallen. Somehow, he didn't think they would

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have time for that.

Another burst of light rippled along the translucent walls. "This doesn't seem like a good place to be, whatever is about to happen," he said.

"There's only one place to go," she said. "And that's down."

"Come on, then." Jason stumbled forward. "Hurry! No telling how far away we have to go before it's safe." He stooped to set down the heavy diagnostic pack. No way was he going to carry that thing at a dead run.

On the surface, he knew Cyndi Salito and Bryan Zimmerman were sitting on Ground Zero—in more ways than one—but he knew of no way to warn them. They would have to fend for themselves.

The two of them bounded around the panels behind the weird building, through an intersection, to the tunnel beyond. Erika's illumination bobbed through the murky catacombs. She pointed the light to a series of openings in the wall. The beam skipped from entrance to entrance. "Which direction?"

"The lady or the tiger," muttered Jason. "Maybe it doesn't matter." He looked behind them, but he could not see through the darkness. He turned back to Erika, then on impulse, he headed into the middle opening. "Only one way to find out."

Erika entered the tunnel beside Jason and stopped. "Wait!" She reached behind her to where the fiber-optic line was attached to her suit, disconnected it, then let the end drop to the floor. "I hate to do this, but if there's going to be some big energy surge through the tunnels, I don't want to be wearing an antenna hooked up to my suit!"

Jason hesitated. They would now be cut off entirely from the outside world, unable even to transmit out. And they wouldn't be able to follow the strand back to the surface like a lifeline. He shivered at the thought of being lost down here in the dark.

"Oh, well, it didn't work for Hansel and Gretel either."

Leaving everything behind, they hurried onward.

The next opening turned out to be an archway, tall and narrow. As they passed under it, Jason heard static clicking over his suit radio, then his suit suddenly grew slack and more comfortable. "What the . . . ?" He checked the heads-up display beamed on the inside of his faceplate.

"That sounded like your electrostatic curtain back at Columbus," Erika said. "Snap, crackle, and pop."

Jason studied his suit display. The readings confirmed his suspicions. "I'll be damned! We just entered an atmosphere. That must have been some kind of screen to hold in gases."

Erika took a moment to answer. "I wish you hadn't left the diagnostic unit. We could tell what the atmosphere consists of."

Jason checked his air gauge. "I'm not taking off my helmet to check. We've got plenty of reserve in our tanks for a while." He drew a deep breath, pumping up his courage.

They entered a sprawling chamber, vaster than anything else they had seen under Daedalus. Erika's light never quite illuminated any one object, but showed enough to leave them both awestruck. Jason couldn't tell the scale of what he saw—the ceiling and walls

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were too far away for him to judge distance.

He tried to make sense of incomprehensible images: soaring buildings that twisted in odd helixes, glittering crystalline structures taken from a distorted Escher woodcut, rectangular plates that extended at random angles from the floor, arches that looped unsymmetrically.

They stood trying to absorb the sight, made even more difficult by Erika's tiny exploratory light. Finally Jason whispered into the suit radio. "Sensory overload." He swept out a space-suited arm that moved freely now in the pressurized environment. "My brain can't comprehend any of this stuff."

Erika switched off the light. The dull UV glow had increased enough for them to make out hazy forms. "Much brighter here. I can almost see."

"So what does that mean?" he asked.

"With the atmosphere? I bet this is where the aliens live."

Jason's first reaction was to turn tail and run. But the only path that they had found led back to the unprotected corridors—and something was going to happen out there. He could feel it. Not that the Rube Goldberg contraptions here made him feel any calmer.

It took a few seconds for his heart to stop pounding, but when no bug-eyed creatures came swarming out of the buildings, he calmed down. He tried not to let his voice crack when he spoke through the helmet radio. "So where do you think the aliens would be? Or is this just a staging area, waiting for a colony ship to arrive?"

"How can there be any aliens yet? They just sent their nanocritters to build this place."

"But what about this atmosphere? Why else would your nanocritters fill this place with gas—presumably breathable to the aliens—and keep it enclosed with some sort of barrier if it isn't meant to house living things for a few decades yet?"

"I don't know." She was quiet for a while as their eyes grew used to the dark. "Hey Jase, see that building over there?"

Jason squinted through the darkness. He couldn't see as well as Erika. "I only see one thing that looks anything like a building—kind of low, flat-roofed?"

"That's it."

Erika switched her light back on, driving back the dark blue haze. Under harsh white light, the place appeared no friendlier. She moved the light slowly over the underground metropolis.

Visions of old "sci-fi" movies flashed through his mind—long tentacles emanating from flying saucers, death-rays smoking the ground, scantily-clad women gasping in horror as they were kidnapped from Earth. Fighting back the paranoid snapshots from his imagination, Jason took hold of Erika's arm. "Come on. Let's finish looking around."

They moved to the low-slung building, passing weirdly shaped objects on the way. The things reminded Jason of displays in modern art museums, conceptual sculptures that had meaning to the artist and little else. For all Jason could tell, the objects might have been anything from street signs to water clos-

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ets. Erika's light scattered off the objects, making the curves and shadows look even more exotic.

After skirting a gnarled tower that twisted up from the floor, they arrived at the building.

"OK," said Erika, "how do we get in?" The walls appeared to be one continuous flow of black-speckled weave. As they looked closer, the building's edges appeared more rounded than sharp, as if it extruded upward from the floor.

Jason stepped forward. "If it's really sophisticated, maybe it'll let us inside when we approach. You know, less work for the users. At least that's the way *I'd* design things." He walked up to the building, but nothing happened. He touched his helmet against the wall. No opening appeared.

He kept close to the building and moved along the wall. "The door could have a sensor that prevents anything other than the builders from entering. To keep out alien dogs and cats."

"Maybe it isn't even a building," said Erika. "How about a water tank? Or a humongous foot rest. Who knows?"

Just as Jason reached the end of the building, an opening dilated, melting outward in a plastic flow. "There," he said. "I knew I'd find it."

Erika flashed the light around as she joined him at the opening. "Should we go in?"

"What have we got to lose now?"

When they stepped into the building, the bluish tinge increased in intensity, as if they had stepped into some kind of greenhouse. Row after row of bubble-covered boxes filled the area—each item presumably assembled where it stood by the nanocritters. The translucent boxes were crowded next to each other, basking in the UV.

He stepped up to the nearest bubble-box and extended a gloved hand. Erika held the light steady; Jason could hear her rapid breathing over the radio. "Careful, Jase."

As he got closer to the bubble, he said, "What do you think is in here—plants? A mineral bath?" He bent closer, then froze, suddenly recalling a vision of hideous Hollywood alien parasites hiding in eggs, waiting to latch onto the faceplates of hapless space explorers.

"Can you see inside?" Erika didn't offer to look herself.

Jason's glove touched, then passed through the surface of the bubble. He jerked his hand back. "What the hell?"

"Hey, look!" Erika directed the light over the tops of the bubbles in the room. As the beam of light hit them, they glowed brightly, became more transparent. "I bet our light is too far down in the spectrum for the aliens to see, so maybe this is their equivalent of an infrared image to us."

Not touching the bubble, Jason bent over to see into the box through the bubble field. "Give me a little more light here?"

Erika brought the light closer. "My God. . . . "

The box held a pale gray thing, not more than a few centimeters long and a centimeter wide. At first it looked like a plant, a mutated piece of asparagus, but as Jason watched in horror, the thing twisted in its box.

"It's an incubator," breathed Erika.

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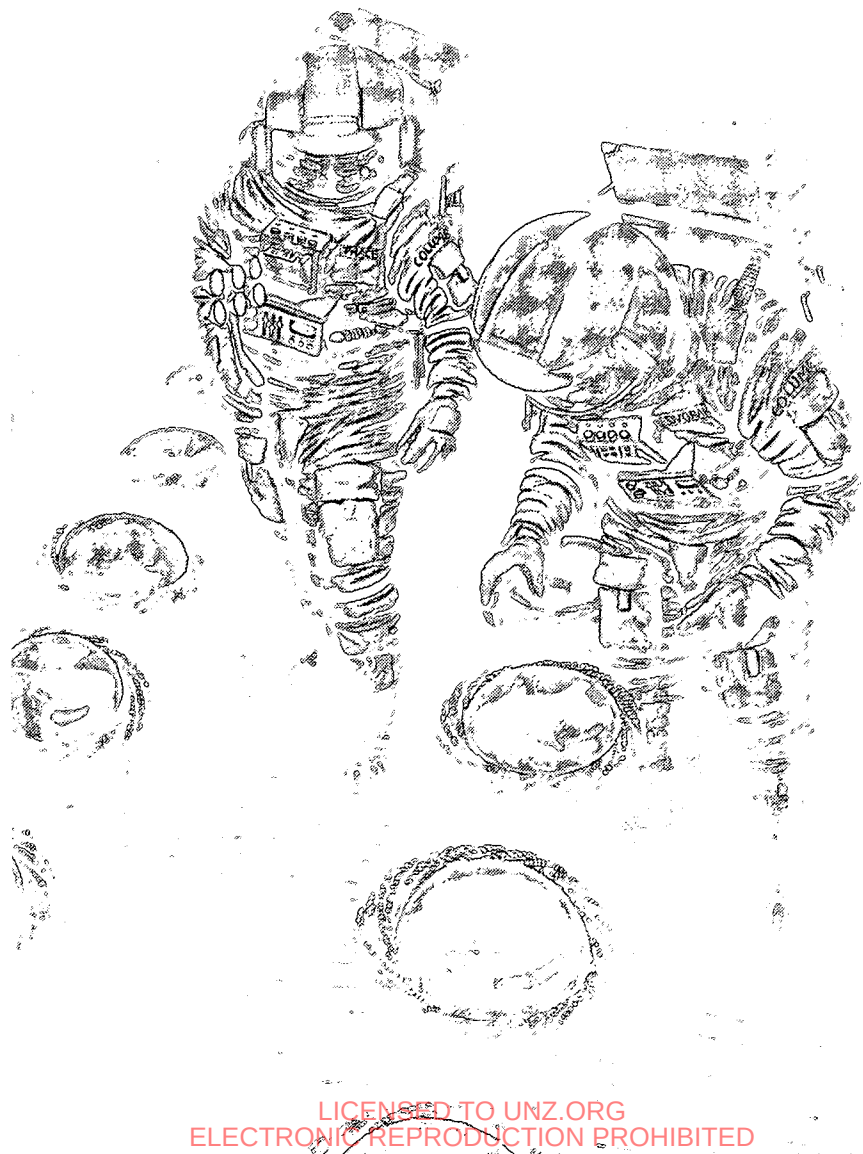

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"These things are alive."

Jason watched wordlessly. It took a few seconds, but he could make out signs that the thing in the incubator was being nurtured—tiny black threads ran across the bottom of the box, connected to the creature's outer membranes; black fluid ran from a minuscule tube to the bud at one end of the creature's length; the box jittered, keeping the creature constantly in motion.

Erika took a step back. She flashed the light into the rows of incubator boxes around her. Jason drew in several breaths, recalling how many similar buildings they had seen inside the enormous cavern. How many embryos were being grown here?

His next thought was that the creatures' parents might be somewhere around, giant versions of the same entity ready to charge in and devour the two of them for disturbing the . . . nursery. He looked around the place; nothing moved, nothing seemed different from when they had first come in.

"What are they doing—growing, feeding, or what?" Erika's voice sounded shrill inside his helmet. "What if we set off some sort of alarm? What if they know we're here?"

Jason tried to comfort himself at the same time. "If there are any aliens, we should have set them off a long time ago."

Erika edged toward the opening. "Let's go," she said. They backed out of the building, leaving the incubators behind. "Back up to the surface, see if Columbus got any of our transmissions."

As they stepped back into the primary chamber, Jason felt more and more uneasy. They were still surrounded by silent, UV-laced darkness. He somehow sensed that they had violated a growing ground.

Erika flashed her light from side to side in jerky spurts. Nothing had changed, as far as they could tell. Everything remained quiet. "I don't like this. I don't have a good feeling about this anymore," she said. Jason could hear the sound of her breathing grow quicker.

"Don't make it any worse," said Jason.

"Let's get out of here." Her words sent a chill running through Jason, like an ice-cold razor that sliced across his skin. He knew they were just getting jumpy, feeding on each other's growing panic.

After what they had been through, why would something just be hiding out there, waiting, when it could have sprung at them long ago? Unless they had set some kind of machinery in motion, some kind of robotic guards. . . .

A loud crack rolled through Jason's helmet. The sound came in a sudden pop and a high thrumming, as if something had smacked against his helmet. The sound went on and on, a lightning of white-noise that rattled through his head, roaring like a tangible force over the coatings of his suit. His heads-up displays swirled colors and meaningless numbers across the viewing area of his faceplate.

Somewhere in the suit radio, he heard Erika scream, drowned out by a high shriek of static. He felt everything growing blacker around him, cutting off every thought in his head.

The Daedalus construction was send-

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ing its own transmission across the Galaxy, back to the builders' home world.

CHAPTER 34

The Daedalus Construction

Jason could barely hear himself speak. "Erika?" His voice sounded far away, as if his helmet were filled with old socks. The suit radio crackled and hummed with static.

No answer.

"Erika? Can you hear me?" He had a sudden thought that the suit transmitter was dead. His heads-up display confirmed that he had blown two solid-state fuses in the control pack, but everything should be up and working. He had a spare if necessary. Good thing the life supports hadn't fried from the pounding of the alien signal. But what if Erika's suit—

"What was that?" Erika's voice sounded as if it had been transmitted through a layer of cotton.

"A signal," Jason answered after fumbling to reroute the radio fuses to their backups. "A new alien base declaring itself ready." It was the only thing that made sense.

"My God, what would have happened if we had been out there in the chamber? At least here we were shielded—"

Jason worked his jaw and tried to pop his ears until the muffled feeling faded. "The relay station we left up top was probably knocked into orbit."

"Do you think Cyndi and Bryan are all right? If they were in the hopper waiting for us . . . " her voice trailed off.

Jason felt his stomach muscles knot. "Let's just hope they had some warning and got to shelter. Maybe they're asking the same questions about us right now."

Erika turned away. She panned the light over the alien construction, pausing at the building from which they had exited. Neither of them knew what to say.

Jason could see strange architectural shapes rising from the floor. Some looked grotesque in the shadows; others seemed frail and spindly, as if they were designed on a planet with gravity much lower than Earth's.

"None of this makes any sense to me yet," Jason finally said. "There's a whole city down here and no . . . *adults*. Where are the builders? Where did those embryos come from? Is there some sort of a ship or projectile we haven't found yet?"

Behind her faceplate, Erika shook her head. "No, Jase. No macro-sized projectile. If the theory is right, the builders fired off automata across the cosmos like shotgun pellets. Swarms of them. You can accelerate nanomachines near to the speed of light. No macroscopic projectile could accelerate that fast without damaging itself, without hauling tons of fuel behind it. That doesn't seem to be the way the alien builders think. The nanocritters did all the work for them here."

"So how did the embryos get to the Moon?" he asked. "They had to come from somewhere. Are you suggesting that nanocritters built them, too?" He paused, shocked at his own suggestion. "It seems like black magic to me, Erika—nanotechnology assembling things on a molecular level. Bridges, transmitter dishes, or power plants is one thing—I can do that, given the proper

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materials and equipment. But living, breathing organisms with functional cells? DNA information is a billion times more complicated."

Jason watched her as she swung the light around. From the back he couldn't decipher her body language, insulated by the suit. She took a few steps away from the incubator building and toward a series of towers.

The floor of the grand chamber was scattered with a plethora of objects that seemed to have no purpose or order. Wispy crystalline gardens, mechanical trees, half-formed arches that stopped in mid-plunge to dangle in the air.

They walked among shapes that grew out of the ground. Solid triangles tipped on their sides, large spheres crowning slender poles, and panels that jutted out at crazy angles from the main structures.

Erika finally stopped before a tall trapezoidal arch flared with bright purple arcs. It led into another gallery that seemed to go on forever. After hesitating, she stepped through the arch.

Inside the gallery they roamed along a parkway of columns built of the same diamond-hard material, stretching as far a their light could reach. It reminded Jason of the ancient Parthenon.

Erika pointed at what appeared to be many-sided datacubes protruding from each tall column. Jason touched one of the fist-sized objects and it detached easily. He turned it over in his glove. "Buckyball, I think. Buckminster Fullerene, a humongous carbon molecule. Our biggest ones are barely large enough to see under magnification. Look at this sucker." Jason stuffed the object in his suit's sample pouch. "Used for information storage, maybe? I wonder if this place is a library."

Jason no longer felt the fear that had grabbed at them just before the radio burst. There was a sense of serenity now . . . of knowing that whatever happened next, they couldn't be overwhelmed by events. Not after what they had already seen.

They poked into other buildings, always finding the self-dilating opening on one wall. In one structure they discovered what appeared to be exercise equipment. An assembly hall? A classroom?

Finally Erika spoke. "I'm not sure we can even guess what the purpose is. But it looks like those embryos have absolutely everything ready-made for them when they grow up."

From beyond the rim of the crater, Cyndi Salito sighed into the hopper's radio link as Bryan Zed replaced another fuse. She had been right in the middle of an argument with Bernard Chu when the last fuse had blown, but now they should be all fixed.

"Dr. Salito, are you there again?" Chu's voice crackled back at her. Zimmerman hadn't even tried to restore the video circuits yet.

"Look, Bernard—we're going to go in after them, no matter what you say, right, Zed?"

"Right."

"So why don't you just give us your blessing? If we have to defy your orders in front of everybody, you're going to look pretty stupid."

She tapped her fingers on the control panel. When Chu finally responded, she could almost see his livid expression.

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"One hour, maximum. Keep in constant contact. One of you remain with the hopper while the other goes down. Follow the fiber-optic cable as far as you can. And be sure you listen for another movement of the antenna, just in case it decides to transmit a second signal. You might not be so lucky next time." Then his voice sounded calmer. "We all hope you find them."

"Gotcha." Cyndi turned to Zimmerman. "So who goes in? Do you have a coin to toss?"

He merely grunted. Cyndi grinned. Any other answer would have told her something was wrong.

Jason was startled to hear Cyndi Salito's voice over the radio when she had descended far enough into the catacombs. Her suit radio waves must have reflected through the tunnel to the alien city. Together, he and Erika worked their way back to the force field trapping the atmosphere inside the main chamber. Cyndi had followed the fiber-optic line along the main catacombs past the matter-antimatter reactors until she reached them.

Cyndi's eyes were wide when Jason pulled her through the field into the self-contained environment of the builders' outpost. "We didn't get any images once you dropped your line," she said. "Wait until Columbus sees this!"

"It's just the beginning," said Jason. "Wait until you see *this*."

Erika led Cyndi to the incubator building, talking quickly, her voice sparkling with excitement. "We couldn't understand why an entire city would have been built without the aliens. Who was going to live in it? There's everything here, ready to occupy—a library, classrooms, power plants, communication facilities—"

"At least we think that's what most of the stuff is for," Jason interrupted.

"If the nanocritters were building this complex because another civilization wanted to colonize the Moon, then where are the aliens? Are they traveling by slow ship? If so, why would the nanomachines be programmed to build the entire complex right away, rather than just the transmitter to report back to the alien home world and ask for further instructions? I mean, the nanocritters could finish up any sort of construction long before aliens ever got here in person. So why do everything now?"

"Did a ship get here first and set off all this stuff?" asked Cyndi.

Jason led Cyndi down one of the sweeping arched corridors. "You told us yourself that another signal was broadcast from Mars, so we have to assume the nanocritters got there, too, and built the same sort of construction. Not very discriminating, are they? How would they know if their 'accidental colony' was in a good location or not? They don't even seem to care."

Cyndi laughed. "My mind is spinning as much from these crazy ideas as it is from these crazy artifacts!"

Jason gripped her suited arm as they turned toward the incubator building. The soft door dilated and poured open, revealing the brighter purple light inside. "Now it's time for you to meet the aliens."

"What!"

Inside the chamber with rows of bubble-boxes, Cyndi was speechless, peering through the walls at the slowly

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squirming alien infants protected in their incubators. They appeared soft and gelatinous, with changing details across their skin. Jason tried to imagine what an adult might look like.

"But how did they get here? You said there wasn't any ship. And how could little organisms like this have survived such a long trip? Cosmic rays alone would have destroyed most of them. Even if they had been frozen, they wouldn't have survived the impact."

"Nanocritters again," said Jason.

"We figured it out, I think," Erika continued. "With all those regolith samples I took back to Sim-Mars, I always found a 'species' of nanomachine that didn't seem to have a purpose. It just sat there waiting, while all the others did the disassembly, assembly, controlling, reprogramming.

"Now, I believe those tiny machines were the genetic carriers. Their entire memories were filled with instructions of how to assemble alien DNA, atom by atom. Building a complete organism would be impossible, I think—and then how do you make it come alive? No, but with a single strand of DNA, checked and double-checked by quality control nanomachines, they could effectively grow clones of whatever alien individuals provided the genetic blueprint."

Cyndi was breathing hard. "This is getting too tough for my brain to handle all at once."

Jason pointed to the incubator machinery. "Look at this equipment! It's built to nurture the growing clones. Look how far they have come in only the few months this complex has been available. The datacubes, the buildings, the living facilities here—it's a complete colony, ready made."

Erika kept turning around, shining her light on the bubble-boxes. "Once the whole complex was completed and the embryos started growing successfully, the necessary systems determined that this place could indeed support the alien life. So they transmitted a signal back to the home planet, informing them the colony was completed. Even if the aliens only come by slow ship, they already have a skeleton colony here—buildings, facilities, and more importantly some of their own kind, brought up by machines, to help populate the place."

"But why would they want their children here alone, just waiting for them?" asked Cyndi.

Erika sounded grim. "Maybe this first wave of clones was considered disposable. Maybe they're being brought up as slaves for when the real builders get here."

They were all silent for a moment.

"So that means whenever the signal is received by those aliens, we can expect some visitors—coming to our Solar System to colonize?" Salito whispered.

"There's plenty of room in our Solar System for a lot of things," Jason said.

"Not if those aliens are shotgunning out colonies this way. I must admit, it's a nifty way to populate the Galaxy, but we still don't know what they're like," Salito said. "How are we ever going to find out enough, in time?"

Jason drew in a breath and looked around. "They can teach us themselves. If all this equipment is to instruct the embryos, then we can be here to listen in, maybe even befriend these

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clones, influence them to be sympathetic to us poor Earthlings when the rest of the gang comes along."

"Reminds me of Tarzan," Salito said. "Raised by apes, he was more sympathetic to the jungle than he was to humans."

"Remember, there's another pristine colony on Mars," Erika said. "Judging by that first signal."

"At least we'll have some time to study their culture before the parent aliens arrive," Jason said. "The only question is, how long do we have?"

EPILOGUE

The holotank displayed a representation of the Galactic neighborhood. Bright points of stars scattered out in three dimensions, showing how vast the spiral arm actually was, how far apart the individual stars were in the Milky Way, and how insignificant Earth's Sun was in the whole array.

"We've traced it to here," said Lieutenant General Simon Pritchard, reaching up to indicate with one finger. The white point he selected grew brighter to call attention to itself.

"This star is L145-141, a 'DA' white dwarf. The Daedalus transmission was directed there. L145-141 is a 30,000 degree UV radiator, located in Centaurus. Also, that star emits a Fraunhofer 't' iron line at 2.99944 angstroms, exactly ten billion times smaller than the diameter of the Daedalus construction. It's our 'smoking gun' evidence. L145-141 is only seventeen light-years from Earth, practically right next door in the scheme of things, as you can see. Nothing particularly exciting about it, except that we now know the 'Builders' live there."

In the big simulations room, the new director of the United Space Agency nodded. General Pritchard was reminded of the time so long ago—or at least it seemed so long ago—when he had first met Celeste McConnell in here, showing off his simulation of an Icarus asteroid impact.

Forget about Icarus, General, Celeste had told him back then. *Let me show you exactly how interesting Daedalus has become.* And she had been right, but neither of them could have guessed how many unexpected things would happen.

Agency Director Bernard Chu sat back down in his chair and frowned. His face looked pinched; lines of weariness surrounded his eyes. Pritchard knew the wiry man was having trouble adjusting to Earth's normal gravity. Chu had been away from it for six years; no wonder he had to rest frequently and sit down when most other people could stand. His muscles would take a while to build back up. Calcium supplements would restore what his bones had lost. Chu was on Earth to stay now.

"So what you are saying," he said, "is that the . . . person who will receive the Daedalus transmission must wait seventeen years before he can even pick up the phone and say hello?"

"Yes," Pritchard said, "and another seventeen years with a response traveling at the speed of light before we can hear it back here."

E.T. phone home! he thought. The movie had just been re-released in a new three-dimensionalized version, despite the aged director's strenuous objections. A month ago, Pritchard had asked

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Celeste to see it with him, but she would no longer speak to him.

The Agency had struggled to keep the details of her attempt at destroying the Daedalus artifact away from the newsnets, and had for the most part succeeded. Celeste had been removed from her position quietly and transferred to a minor post in a little seen and little heard department in the administration.

"I thought nobody expected stars of that type to develop life," Chu said.

Pritchard shrugged. "Nobody's saying that's where the Builders originated. They could be hopscotching across the Galaxy in waves, wherever their nanoscouts happen to land and set up a transmitter. But it makes sense, since it appears they see in the UV."

He pulled up an image of L145-141, taken with the optical interferometer on the lunar surface. The picture had a resolution a million times that of any Earth-based telescope.

Bernard Chu rubbed his temples. Pritchard canceled the image of the local star map and wondered if there was anything he could do. "I'm here to assist you, Dr. Chu. Please let me help if I can."

Chu sighed and looked at him, forcing a smile. "I am still acclimating to Earth, and I feel tired all the time. I cannot drink coffee, though I believe I could stand some weak tea. I don't know how I ever tolerated this gravity before! It's like wearing clothes made of bricks."

Pritchard laughed. "Would you like anything in your tea?" He touched the intercom panel. Chu shook his head.

While they waited for the tea, Chu tapped his fingers together. "It is also imperative we go to the site of the other signal on Mars. Even with thirty-four years before we can expect an answer from that star, it's going to require all of our resources to find out everything we can about the Builders. I am also putting Erika Trace in charge of the investigation team at Daedalus. She and Dvorak seem to work well together, and neither of them wants to come back to Earth."

"By the time we get a response from that signal, we better make sure that we know everything we can," Pritchard said. "It's in our best interests."

Chu nodded. "The United Nations has already agreed to issue a statement announcing that the primary mission of the United Space Agency is to do just that."

Pritchard agreed. "From now on, it has to be the primary mission of the human race."

Jason Dvorak sat back in the transmission booth on Moonbase Columbus. He couldn't keep himself from grinning. His two children, Lacy and Lawrence, pushed their way into the field of view, giggling. Both had dark, curly hair; Margaret had dressed them in identical tie-dyed tunics.

"We saw you on the newsnets, Daddy," Lawrence said, bouncing with excitement.

Lacy stuttered her sentence several times before she finally managed the words. "Did you really go out there to that place? Were you scared?"

"Yes, I did go there, and yes I was a little bit scared. That's where I'll be working for quite a while. There's a lot of things we still need to see."

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"Say goodbye to your father now," Margaret said, standing behind them and placing protective hands on both of their shoulders. They waved at him before Margaret scooted them out of the field of view. She stared at Jason in silence for a moment, much longer than the transmission delay made necessary.

Margaret looked like a stranger to him. He recalled with a detached portion of his mind how attractive he still found her, but he could not summon up the feelings he thought he had once had. How could anyone go from love to apathy in such a short time? He didn't understand it himself.

"For what it's worth, Jase . . . Jason . . . you did do something important up there. I can see that." Then she set her mouth in the way that made her look ten years older. "It's too bad you set your priorities that way instead of with us."

Jason froze his expression, refusing to let any emotion show. That was probably what she wanted, just to jerk his chain. There was no winning with Margaret. He had to accept that. His best escape would be to let it drop. Drop entirely.

And so he did.

Erika kept up with Jason as they jogged around the Columbus track. She had finally begun to feel exhausted, and sweat made her running suit cling to her skin. She still hadn't started panting from a real workout, though she and Jason had run a full twenty kilometers already.

They seemed to glide in the low gravity. She felt a sudden pang inside as she thought of the unfolding wonders at Daedalus. "Sometimes it overwhelms me, just trying to imagine it all."

Erika flicked a glance to her left to catch his expression. She could tell he was thinking about his ex-wife again, not Daedalus. He said, "At least my kids were impressed by what I'm doing up here."

"I'm impressed," Erika said. She put on a spurt of speed, catching him by surprise. Jason increased his stride to keep up with her.

He kept talking. Sometimes, he just needed to get his thoughts out into the open. "I don't know what to do about Margaret. I've tried everything. Should I care?"

Erika shrugged. "Some people just don't like to be challenged. She seems to be one of them. But you and I—we have a heck of a challenge at Daedalus."

Jason nodded. "And a lot of waiting."

"That's OK. That's why I like older men."

"Oh? Why's that?"

Erika smiled to herself. "Because they're patient." She pulled ahead of him.

Laughing, they sprinted toward the finish line. ■

●The closed mind, if closed long enough, can be opened by nothing short of dynamite.

Gerald Johnson

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BIOLOG Jay Kay Klein

DOUG BEASON

Sometimes an "All-American Boy" turns out to be intelligent as well as wholesome and athletic. Doug Beason was an Eagle scout, football player, and a rock musician. After a year at Louisiana Tech, he secured a competitive appointment to the Air Force Academy. With a degree in physics and mathematics, he later attended the University of New Mexico for an M.S. (Cosmic Radiation) and Ph.D. (Radiation Hydrodynamics) in physics.

Military duties included heading up an air force plasma physics lab and an advanced concepts group researching the exotic weapons long familiar to *Analog* readers as death rays: particle beams, plasmas, and high-power microwaves. He was also an assistant professor of physics at the academy. Now a lieutenant colonel, he is on the White House staff for the president's science advisor, where he gets a close-up view of history in the making. Another *Analog* author, Dr. Arlan Andrews, profiled in a 1987 "Biolog," joined this group last year.

Long a science fiction reader, he started writing stories after completing his doctorate. While working an hour or two every night, Doug has written six novels plus an assortment of magazine stories, including his first *Analog* appearance in October, 1989. These have been sandwiched in between dozens of peer-reviewed scientific papers.

On a sabbatical at the Lawrence Livermore National Laboratory, he ran into Kevin Anderson. Their plotting together led to *Lifeline*, based on Doug's experience in the Philippines. A second collaboration, *The Trinity Paradox*, came out of their dealings with the Los Alamos labs. This won the distinction of being the only novel ever reviewed in *Physics Today*. In addition to more collaborations, a solo effort of Doug's is under way, based on what he learned while on a commission headed by astronaut Tom Stafford. This was tasked with giving the president options for Moon and Mars missions.

Doug is still an all-American type: jogging, traveling, cooking, church activities, and playing guitar, trombone, and piano. Only, now to fit in everything, he has to squeeze in writing time on a laptop while commuting 35 minutes each way on the Metro between home and the White House. ■

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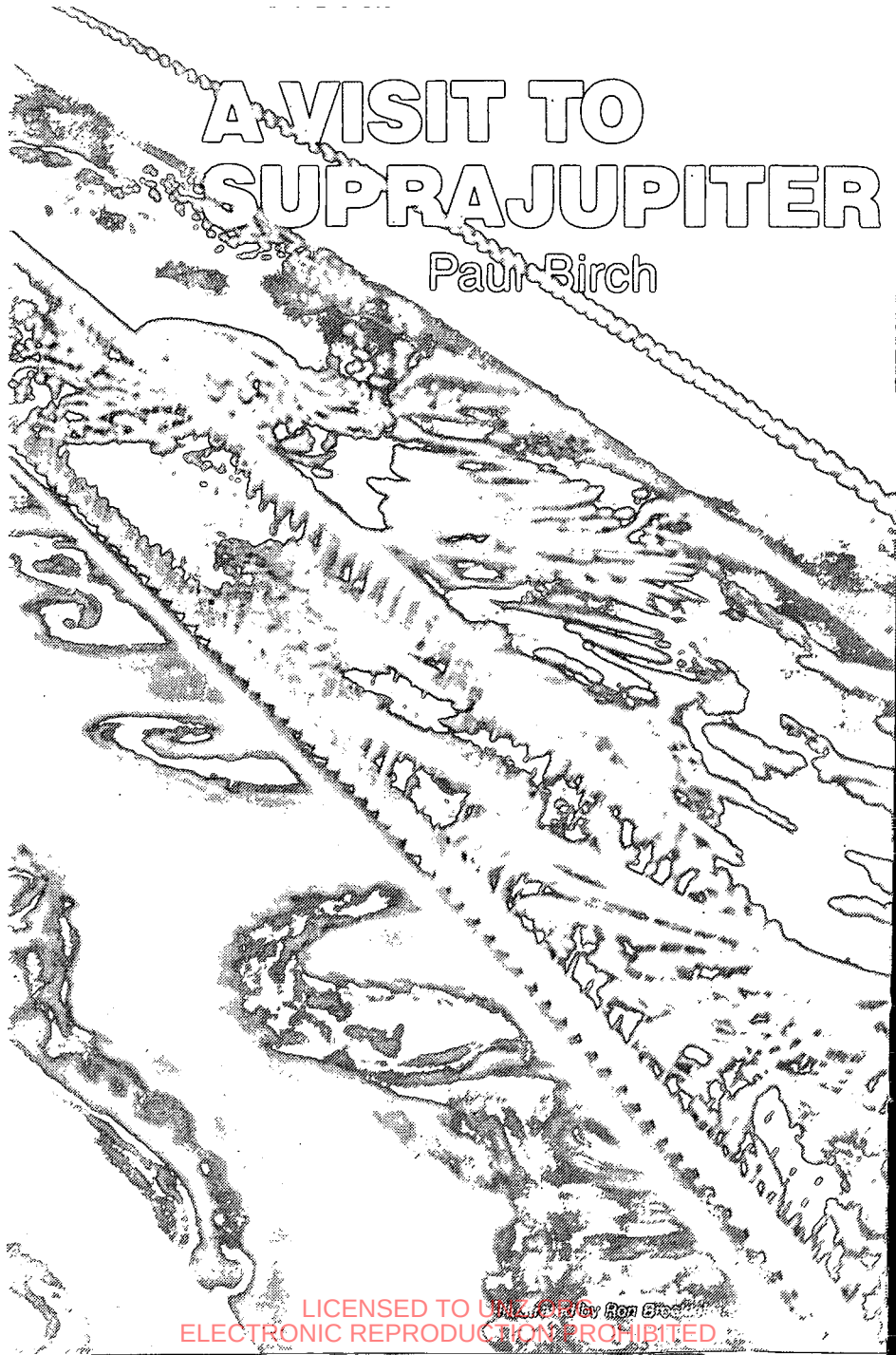
A VISIT TO SUPRAJUPITER

Paul Birch



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It's 2100 A.D., *and the eve of your great-great grandson's eighteenth birthday. You've come all the way from Princess Diana Land to see him; after all, comings-of-age don't happen every day, not since most of the family emigrated out-system to Epsilon Eridani. The fact is, you haven't left L5 since retiring there fifty years ago. PDL has all you need: larger than most Earthside countries, it has a homey backwoods feel, yet larger and more cosmopolitan colonies orbit only a spacehop away. If the sunsets aren't as good as Earth's—no proper horizons, you see—you only pretend to miss them. Still, you have to admit you're looking forward to Suprajupiter.*

The journey to Jupiter takes under six days by MOLONET—the new interplanetary momentum loop network—but you prefer to patronize the old MHD clippers still sailing the solar wind. Slower—at nearly a fortnight's passage—but more elegant. Then in high Jupiter orbit you transfer to a loop capsule for the final stage of your journey.

Amongst the colored bands and great whorls of the Jovian weather systems, you pick out the dark shadow of Suprajupiter; at this time of year a thin belt falling just to the north of the equator. High above is the strip habitat itself, all blue and white, with sharp edges, a shining ring encircling the giant planet at a great height. Higher yet, and all but invisible, a mirror strip 50 times as wide focuses sunlight down onto the habitat.

It reminds you of the earliest Stanford-torus space colonies, where close walls line the narrow valley. But as your capsule swoops down into the atmosphere you see the difference: this world has an open sky and, along the strip, a horizon. To the side the glimmering gasbag walls seem to hint at distant snowcapped mountains.

You decide to walk the last kilometer to the house, sending the capsule on ahead with your luggage. A degree to the south of west, the sun is sinking towards the . . . yes, towards the horizon . . . behind the thin crystal walls. What a sunset . . . and what a sun: a horizontal strip of fire over five degrees of arc, now clothed in sparkling reflections as if mirrored in a rippling lake. An icy brook from the peripheral mountains splashes down beside the path. Your shoes click on the steps and crunch on the gravel. A church bell rings in the valley below. Pine scent sharpens the teatime air. Tired but happy, you press on up to the house, one of a dozen built into the side of the hill.

Your great-granddaughter opens the door herself. Her face lights up. "Grandest! How good to see you! Did you have a pleasant journey?" You smile. Ultra-modern Suprajupiter has not forgotten the old-fashioned courtesies.'

Space colonies that rotate for gravity are by now familiar concepts; the conventional designs[1-3] are wheel-shaped or cylindrical. But limitations of material strength tend to restrict us to habitat diameters up to about 400 km for quartz, or perhaps 5,000 km for diamond.

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In a rotating space colony there is no natural horizon (although fractal relief[4] helps make a realistic skyline), and weather may not always follow planetary patterns (since the Coriolis force is oriented axially).

These disadvantages are not serious: within a century or so most of the human race will probably live happily in such space settlements; and it is unlikely that natural planets will ever again accommodate more than a small fraction of the population.

But suppose we want something bigger, planet-sized or more? We can try terraforming[5], but terraforming has its limitations. OK for Venus and Mars, perhaps—not so hot for Jupiter and the outer planets. The answer is dynamic support[6–10], for dynamic support techniques are not dependent on material strength.

Imagine englobing an otherwise uninhabitable planet with a new landscaped surface, at that radius where the gravity is just one *g* (9.81 ms^{-2}). Such an artificial planet would have all the outward characteristics of a natural planet: gravity would be directed inwards; the landscape would curve down to the horizon in all directions; and if the planet rotates daily on its axis it will have natural weather, and night and day.

Orbital rings or dynamic compression members[5–10] can support the artificial planet, which could be built up in easy stages from smaller portions. A few centuries from now, such habitats may house a large fraction of the human race.

First, some definitions[10] (Fig. 1). A habitat supported above a planet, star or other massive heavenly body we call a *supramundane habitat* (from the Latin *supra*, above, and *mundus*, world). A

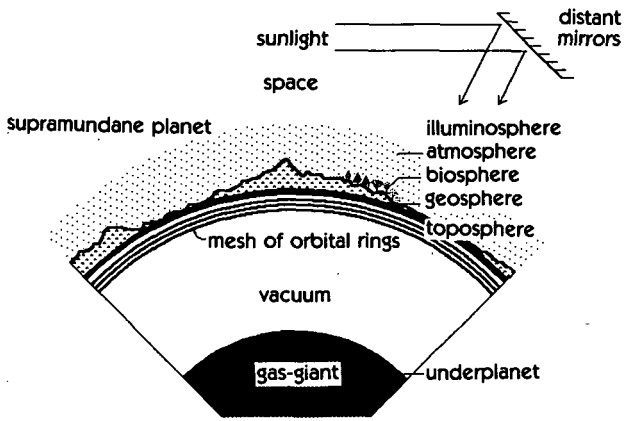

Figure 1: A supramundane planet.

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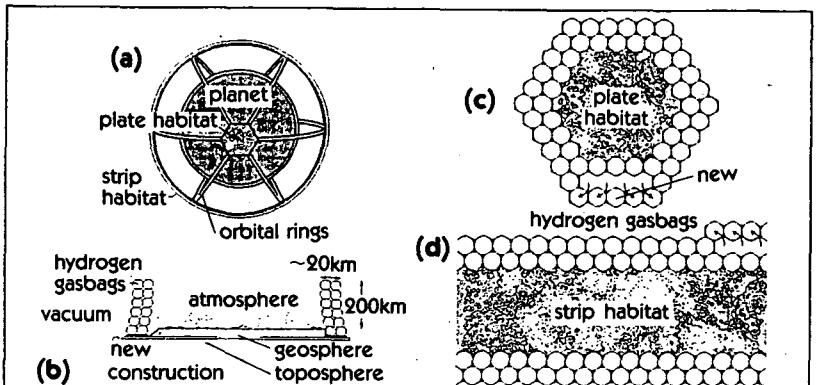

Figure 2: Construction and extension of supramundane habitats (a) Support (b) Atmosphere retention (c) Plate habitat (d) Strip habitat.

globe completely surrounding the gravitating body we call a *supramundane planet*, so an artificial planet englobing a gas-giant is a *suprajovian planet*, and one englobing a star, also known as a Dyson sphere, is a *suprastellar planet*. An incomplete englobement may be in the form of a *strip habitat* or *plate habitat* (Fig 2).

The *underworld*, *underplanet* or *underbody* is the underlying heavenly body, the source of the supramundane planet's gravity. It could be a planet, a star, even a black hole.

The foundation or support of a habitat is its *toposphere* (from the Greek *topos*, place, and *sphaira*, sphere, region). Then comes the *geosphere* (Greek *ge*, earth), the earth, soil, rocks and waters; the *biosphere* (Greek *bios*, life), the living organisms; and the *atmosphere*. The *luminosphere* (Latin *lumen*, light, and *sphaera*, sphere) is the habitat's sky and illumination (the Greek form photosphere has been preempted for the light-giving part of the Sun).

* * *

Evening meal on the veranda looks out across the width of Suprajupiter.

"There's room to breathe here," your gggrandson tells you. "Look at those mountains."

"Almost as pretty as Princess Diana Land," you admit. "Nothing beyond them, though. Only space."

He smiles. "What better? Tomorrow there'll be fields and lakes and still more mountains there. Then even more. Some day the whole of Jupiter will be roofed over. Even now Suprajupiter's the biggest habitat in human space."

"Not Diamondia?" you query.

"Old hat! Only 2,560 km diameter."

"Only!" you say.

"Mind you, the competition's stiff," he says, "with the supra-uranian strip nearly a hundred kilometers wide to our thirty, and growing fast. But we'll win in the end. Jupiter's simply the most massive object in the Solar System."

"After the Sun."

"Right."

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As you speak, the sun's thin fiery line touches the horizon; for three seconds it burns a startling green, then vanishes in a puff of violet. On the mountains opposite, a green band slides darkness up the red-gold slopes; and in five minutes, night has fallen.

To make an Earth-like supramundane planet we need an underbody with a surface gravity of at least 9.81 ms^{-2}. Then if the mass of the underbody is M, the surface area of the supramundane planet is given simply by $A = A_{Earth}\, M/M_{Earth}$.

Thus suprajovian planets around Jupiter, Saturn, Uranus and Neptune could provide respectively 316, 95, 15, and 17 times the surface area of Earth; and a suprastellar planet would have an area as great as 300,000 Earths. It is clear that supramundane planets can provide orders of magnitude more living space than natural planets.

A supramundane planet will be supported and upheld by the flow of momentum in a web of orbital rings or dynamic compression members in its toposphere. The idea here is that the material making up the orbital rings moves much faster than orbital velocity (perhaps even faster than escape velocity) and so has to be held down (by the weight of the planet) to stop it flying off into space. The total kinetic energy stored in the mass-streams is equal to $\frac{1}{2}WR$ (where W is the total *weight* of the habitat and R its radius; for Suprajupiter $R \sim 1.1 \times 10^8 m \sim 1.6 R_{Jupiter}$). It should come as no surprise that this energy is just the amount needed to place the entire mass of the supramundane planet into a circular orbit at that height; a law known elsewhere as the Virial Theorem.

The planet's toposphere displays global stability, for if the supramundane planet started to collapse inwards, work would be done against the orbital rings, increasing the energy stored and hence the outwards pressure. The question of local stability is more subtle.

An Earth-like supramundane planet is essentially spherical; otherwise some parts of the planet would be "lower" than others, and atmosphere and oceans would flow down to them, leaving the rest uninhabitable. Slight periodic adjustments in the shape (a meter or so up and down) will reproduce the effect of tides.

Now rotation of a supramundane planet will distort the sphere into an approximate oblate spheroid. It turns out that the polar radius has to be less than $8g/27\omega^2$ (where ω is the angular velocity); for a 24-hour day and a one-g polar gravity, this is about 5.5×10^8m, corresponding to an underplanet mass of 7,400 $M_{Earth} \approx 24\ M_{Jupiter} \approx M_{Sun}/40$, the limit falling conveniently around the boundary between suprajovian and suprastellar planets. Rotation will also set up the Coriolis forces needed to drive the weather.

Other solar systems may have planets which spin so fast that they are almost disklike[11] (equatorial radius up to $\frac{12}{7}$ the polar radius); rapidly rotating supramundane planets will likewise display lower gravity at the equator than at the poles (in the extreme, the equatorial gravity will drop almost to zero).

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Although it is Earth's 23½° axial tilt which causes our seasons, simple axial tilt of a supramundane planet would make its seasonal cycle equal to its orbital period around the Sun. However, if we counter-rotate the inner toposphere (making the *net* angular momentum zero), we may then precess the rotation axis by means of an orthogonal couple[6–8] to obtain a 365-day year.

The morning of your gggrandson's birthday he gives you a tour of the Suprajovian countryside.

"We'll stick fairly close to home," he says. "Even by high-acceleration loop it's nearly two hours to the antipodes."

Later you discover that "close" is anywhere within ten thousand kilometers along the strip, encompassing a bewildering variety of geography—from open sea to mountain range.

Here you pass through a region of steep-sided round-topped Chinese mountains, crammed with trees bearing oriental fruit. Pagodas perch on the peaks, and transport capsules in the sky are like distant dragons.

Here is a fen country of rivers, open broads, and marshland. White sails move in stately procession amid the reeds. Wildfowl clutters the air and water.

Here an alpine scene—snowcapped summits and ski-slopes above lush pastures dotted with goats and cattle. Cowbells play faintly on your ears.

Here a tropical island, over-jungled, spilling mangrove swamps into the sea.

There, a coral reef . . . coral?

"Artificial. A thin coral crust on a foundation of foamed silica."

At a tourist cafe high in the white mountains, you pause for a well-earned cup of whipped chocolate, and marvel at the panorama of rocky peaks jutting through a carpet of cotton-wool clouds. Inside the mountain is a huge cavern, crystal bright, ringed with balconies and shopping malls, hung with hanggliders in a steady updraft. In the depths is the gleam of water, a marina of ocean-going yachts, a long passage out to the sea, and the endless maze of the geosphere base.

The geosphere of a supramundane

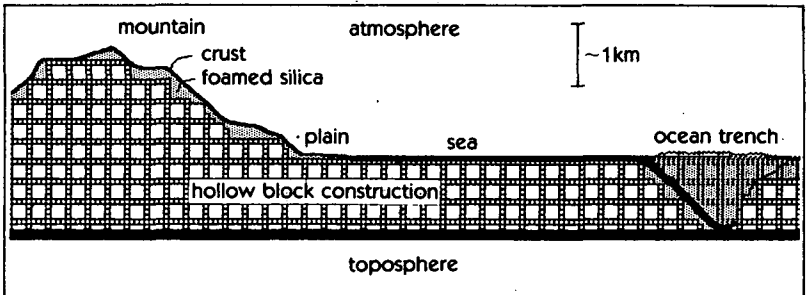

Figure 3: Geosphere with landscaped surface relief.

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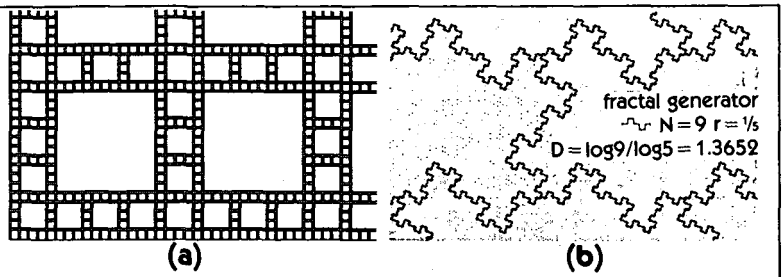

Figure 4: Geosphere construction (a) Fractal architecture of geosphere base (b) Fractal slotted building blocks of fused rock.

planet (Fig. 3), like that of a rotating space settlement, is supported by the toposphere, which forms a level foundation upon which the irregular planetary surface is built up and contoured. A thin crust of rock and soil lies over the geosphere base, most of which is a honeycomb of empty chambers, a fractal sponge[4] assembled from blocks of fused rock.

The geosphere base thus provides an enormous amount of room for storage, accomodation, shops, industry, hydroponics, transport—anything that doesn't need to go on the surface—in its small rooms, vast caverns, deep shafts and long tunnels.

Similar geosphere designs can be used for conventional rotating space colonies, in which fractal building blocks—under tension—can also constitute the toposphere.

In the simplest form, a flat fractal carpet (Fig. 4a) is projected upwards into a honeycomb of tubes or chimneys, an efficient vertical-load carrier, but with little strength in shear. By superimposing three such honeycombs, aligned on orthogonal axes, we obtain a structure strong in shear, efficient at carrying through-loads from any direction.

Masonry construction has little strength in tension, as a rule, a limitation which can be overcome if we key the blocks and slot them together; a mortise-and-tenon joint, however, can only give a tensile strength up to one-third of the intrinsic strength of the material.

Fractal keying (Fig. 4b) can improve on this, fitting the blocks together so intimately that nearly the full intrinsic strength is achieved. Surprisingly, an array of fractal tiles can be *stronger* than a uniform slab, due to its resistance to stress concentration.

We may fabricate these blocks by spraying a mist of molten droplets onto a cooled form, or by vapour deposition; the energy required is only $\sim 2 \times 10^6$ Jkg^{-1}, small compared to the kinetic energy of the orbital rings, but high tensile and compressive strengths (~ 3 GNm^{-2}) will be achieved.

The crust or surface of the geosphere may comprise some five meters of rock and soil or ten meters of water. Fine detail can be molded in foamed rock,

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its rough and irregular surface gripping the sand, soil, and loose rocks spread upon it; where a cave, a cliff, a crag, or a rocky outcropping is required, the rock itself can be fused onto the foundation. Quartz, granite and sandstone are easy; other minerals, such as chalk or limestone, may be more difficult.

This is not the place to detail the geology and mineralogy of these artificial landscapes; but the design of successive space colonies will doubtless lead to ever more faithful replicas of the diverse scenery of Earth. Already, computer programs can generate fractal landscapes of astonishing realism[4].

Weathering should improve the appearance of many features and on a well-designed habitat should not thereafter be a serious problem. Nevertheless, from time to time rivers and seas may need to be dredged, soil erosion made good, and cliff faces repaired. However, such maintainance need cost no more than on a natural planet.

On the homeward leg of your little tour you pass over shallow blue seas, archipelagos of grassy islands, and a wide prairie, over which the black clouds of a thunderstorm are gathering.

"Don't like the look of those," you remark. "Hope it doesn't rain for the party."

He shrugs. "You never can tell with weather."

"Just like Earth."

"Not entirely," he says. "We use a higher fractal dimension, especially on the larger scales."

"What does that mean?" you ask.

"Lots of coastline and lots of islands," he replies.

You sigh. Yes, a pleasant place to live. Almost worth emigrating from PDL.

The atmosphere of an Earth-like planet should consist of $\sim 10^4$ kgm^{-2} of ~25% O_2 and 75% N_2. Helium has been suggested for the primary diluent, since it is more abundant in the Universe than nitrogen, but its effect on the voice renders it unacceptable for general use. However, nitrogen is common enough among the outer planets and could be mined from the atmospheres of Titan or the gas-giants. Oxygen can be obtained from water ice, rock or CO_2.

Photosynthetic transformation of a CO_2/N_2 atmosphere (using green plants or bacteria) might take ~25 years[5]; exotic forms of photosynthesis, extracting oxygen from rock or water, may also be considered. Faster processes may include the dissociation of CO_2 or mineral oxides by high-energy pellet-streams[8]. Rapid photosynthesis during construction may be encouraged with high CO_2 levels and illumination by double-intensity infrared-filtered sunlight.[5,10].

As on Earth, the atmosphere of a supramundane planet will be open to space, protecting the surface from cosmic rays and residual UV.

The climate will be Earth-like, though since the maximum scale of weather patterns increases in proportion to the supraplanetary radius, the weather may tend to be more severe. But since oceans wider than the Pacific are neither

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necessary nor especially desirable, we can easily tame this fierce weather by restricting the size of continents and oceans to the terrestrial scale, thereby breaking up the weather patterns and checking their growth.

"My birthday tree!" exclaims your gggrandson, back home. In the center of the lawn looms a great oak. "It's exactly the same age as me."

You express astonishment, for it seems to tower above all the other trees on the thickly wooded hillside. Yet its trunk and branches are smooth like a sapling's, and the turf around its base looks newly laid. You hug the tree to measure its girth, but your arms stretch only halfway round. "I don't remember it from last night."

"It wasn't there!" he says. "It only came of age today, like me. It must have been transplanted from the nursery while we were out."

Lunch is "local" produce, grown on Suprajupiter. Mushroom soup to start, then steak, roast potatoes and baby carrots, washed down with orange juice, followed by cherry pie and cream, ending with a pot of tea on the veranda. Good food, and plenty of it.

As you doze afterwards in the warm sun, honeybees sip nectar from the garden flowers and fill the fragrant air with their murmur, fresh pine wafts on cooling breezes, and in the distance the snick of ball on willow mingles with the laughter of children at play and the bark of a fox-terrier chasing the scent of sleeping rabbits.

* * *

Earth's biosphere provides food, maintains a breathable atmosphere, and furnishes a pleasant environment. Asking the same of the biosphere of a supramundane planet, we create a diverse and Earth-like habitat.

There we find grasslands, forests, meadows, moorlands, jungle, marshes, scrubland, parks and gardens—even deserts. The life of streams, ponds, rivers, lakes, estuaries, seas and oceans—even sulphur pools. The life of high mountains, alpine uplands, hills, downs, plains and valleys—even of caves and subterranean caverns. Life from the tropics, life from the temperate zones, life from the arctic. Life from continents, maritime coasts and islands.

In short, the lot.

In time, the planting-out of new colonies will become a major industry—like landscape gardening and animal breeding on Earth, but on a much grander scale. Plants, seeds and animals will be raised in dedicated nurseries in the geosphere base or in specialized space habitats.

Most plants, and some animals, can be sown as seeds on the new land, or mixed in with the topsoil (which will consist of crushed rock and a humus of finely-chopped vegetable matter). Since most seed-grown plants come to maturity in a few years or less, this easily-automated process should generate most of the biosphere rapidly and cheaply.

Trees, and some of the larger shrubs, may be transplanted from hydroponic nurseries. In these specialized environments, arboriculture can be amazingly fast: growth can be speeded threefold by

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continuous illumination; threefold again by optimizing the light spectrum; and a further threefold by optimizing the CO_2 level to $\gtrsim$2%. Ideal temperatures (no winter), continuous supply of water and nutrients, and the absence of pests and predators also play their part, so that even forest giants should reach maturity in under a decade.

As soon as the plant life can support them, we can release animals into the wild—in most cases by the end of the first season.

Every species could find a niche somewhere on a supramundane planet (though we may restrict many species to nature reserves or safari parks) but we're not obliged to maintain anything like the same balance as on Earth. I think it unlikely that we shall create more than token areas of swamps or jungles, for example, since they do not appear to be essential to the ecology of a supramundane planet and I suspect that few people will actually wish to live in them. Rather, we will provide the environments that people like and are prepared to pay for.

The bees buzz louder—you slip deeper into sleep. You open your eyes and frown: the birthday tree seems larger and more wrinkled, the mountains less stark against a cloudier and more cluttered skyline. And while you dozed the garden has filled with a throng of guests in solemn finery. Of course! It's thirty years on, your g^3 granddaughter's wedding.

Your gggrandson now has a large estate on the far side of the mountains, but your g^3granddaughter's new home is on an island right up against the habitat wall; from its bedroom window you can just see the edge of Jupiter's disk, peaking over the habitat rim.

"This section was only completed last month," your gggrandson tells you. "Look over to the west!"

There the perspective line of the habitat walls seems broken by a dogleg of new construction.

"We're nearly 120 kilometers wide," he says, and your body balloons out over the landscape, wedging itself between the rubbery gasbags on either side.

"I'm Alice!" you exclaim.

As you continue to grow, the habitat walls slide gradually apart.

Building a whole supramundane planet in one go would be a daunting task, for even the smallest may be a hundred times larger than conventional space colonies. Fortunately, smaller supramundane habitats, covering only a fraction of the area, can be constructed and occupied first. These come in two varieties (Fig 2): plate habitats, supported at the junction of orbital rings or by compression members from below; and strip habitats, supported along their length.

Incomplete supramundane habitats, unlike complete planets, need 200 km-high walls to stop the atmosphere pouring over the side. Figure 2b shows them as hydrogen-filled gasbags. At the base they are heavy, inflated to ~2 bar, with meter-thick walls; but since pressure decreases exponentially with height the

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top uses only thin film $\sim 100 g m^{-2}$. The gasbag columns rest on hexagonal bases at the habitat's edge; inflated, they squash together to form an airtight seal.

In emergencies—natural disasters, accidents or war—similar gasbag columns could cordon off any holes blasted through the geosphere, or any other areas of major damage.

Extension of the habitat is facilitated by the double wall (which also provides redundancy) and proceeds as follows. First the toposphere is extended beyond the wall. Gasbag columns from the outer row are slid out to their new locations (Fig. *2c & d*). New columns are added as required (Fig. *2c*). Next, the inner row is moved in the same way. Then the geosphere base is built up and landscaped, at the edge of the habitat, *inside* the wall; a temporary shallow lip prevents the sea cascading down the exposed base.

Supramundane habitats can thus be made habitable from a very early stage; most new construction can take place from existing habitats. Large rotating space colonies could also be constructed in this economical fashion, by sideways extension of a cylindrical strip.

Suprajupiter is nearing completion; except around the fast-diminishing polar holes, the habitat walls are gone, and the old Jupiter has vanished beneath the new planet, which from where you float in space looks very like the familiar blue-white globe of Earth. Above, the mirror strips have disappeared, replaced by a distant lens five times as wide as the planet.

You look at your watch. "2290 A.D.!"

You swoop down into the west. From the supraplanetary surface the once stark line of fire is now a boring old sun. On the oceans, ultrafast yachts race to circumnavigate the globe. Over land, supersonic gliders wheel in the sky.

Ahead looms the birthday tree—huge with age—your g^8grandson dwarfed in the sunlight at its base.

A supramundane planet may be illuminated by a soletta placed near the L1 point of the underplanet-Sun system (Fig. 5). A soletta is like a solar sail,

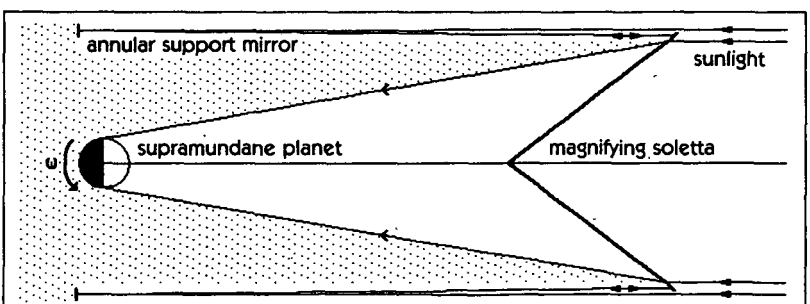

Figure 5: Illumination of supramundane planet.

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its component mirrors arranged so as to form a magnifying "lens"; it can be supported by a *dynamic compression member*[9], utilizing light directed from an annular mirror orbiting on the opposite side of the planet. Light paths through the soletta are quite subtle (see ref. 10 for details).

Magnified by the distant soletta, the orb of the sun in the supramundane planet's sky will appear just the same as on Earth. And if the supramundane planet rotates once every 24 hours, with an axial tilt of 23½° precessing once a year, then the cycle of day and night, the progression of the seasons, and the division of the planet into tropical, temperate and arctic zones will also be fully Earth-like.

We set the soletta radius at RD/D_{Earth}, where R is the radius of the supramundane planet and D its distance from the Sun. Although the soletta may be far larger than the supramundane planet itself, it will be much lighter: its mass will be small out to ~20 000 AU (⅓ light-year). Actually, we could quite easily illuminate an Earth-like habitat using starlight, even in the depths of interstellar space.

Time passes—you return to space—and even Suprajupiter seems small. When your watch reads 2400 A.D. *your g*[12]*granddaughter emigrates to Suprasol—you follow her.*

As you look upon the Sun you see without surprise that it no longer burns unhindered, but is swathed in a dark encircling band. As you draw near the band swells sideways, encroaching upon the solar disk, gradually encompassing a sphere more than five times the size of the Sun. And even as the Sun's poles are finally cloaked, a fierce light pours from a multitude of holes in the new globe's surface, scarcely less bright than the undisturbed Sun itself.

You check your watch before grounding in the endless grasslands. 2500 A.D.

A wide range of astronomical bodies may serve as the underbodies of supramundane habitats, ranging from planets, through stars, up to the largest of galactic black holes.

Supraterrestrial planets, although easily constructed, may not be of great value: small planets, such as Mars, have too low a surface gravity, while the larger terrestrial planets, such as Earth or Venus, can be used in their natural or terraformed state. Supraterrestrial habitats may however be constructed for specialized purposes; above the polar regions, for example, they would intercept sunlight otherwise missing the planet and give ready access to space.

Gas-giants (Jovian planets) make excellent underbodies, up to brown dwarfs of a few percent of a solar mass; throughout this range diurnal rotation and an open sky allow Earth-like and attractive suprajovian planets. As with the smaller planets, these are illuminated from without.

At the next level up we come to suprastellar planets, where the underbody is a star and provides energy as well as gravity. Because the luminary is *inside* the planet, the illumination of suprastellar habitats is rather different from that

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of suprajovians. Keeping them cool is quite a problem; means must be provided to transport waste heat out to a sufficient distance (about 1 AU) and to shield the habitat from the direct rays of the sun.

Any main sequence star or white dwarf is suitable (though regrettably, a full analysis is beyond the scope of this article). And although the envelopes of many red giants, such as Betelguese, are so extended that the surface gravity is less than one g, it turns out that "suprastellar" habitats could be constructed even there, actually beneath the stellar surface. We might even build *intrastellar habitats* inside the Sun. These would use clever thermodynamics and plasma physics to stay cool some thousands of kilometers deep, whilst remaining undetectable from the solar surface.

The end products of stellar evolution (such as neutron stars and black holes) will make useful underbodies too, as will those black holes of greater mass that form in the cores of globular clusters or galaxies. The largest of all suprahole planets might employ a black hole of $\sim 3 \times 10^{12}\ M_{Sun}$ resulting from the collapse of a large cluster-dominant elliptical galaxy; the surface gravity near its one-light-year-radius event horizon would then be $\sim 1g$.

Smaller black holes are not excluded; at the bottom end of the scale a minihole of mass $\sim 3 \times 10^{14}$ kg would pour ~ 400 Wm^{-2} of high-energy Hawking radiation onto a suprahole "planet" of only 45 meters radius.

All kinds of underbody will allow multi-layer supramundane planets; but they will be most appropriate where the underbody provides energy as well as gravity, and where its luminosity exceeds that which can be used by a single layer. For a star like the Sun ten thousand or more concentric layers might be employed.

Most of the larger bodies we see in the universe are thus potential sites of supramundane planets, most of the smaller bodies potential sources of mass, most of the luminous bodies potential sources of energy, most of the energy sources potential luminaries. The potential habitable area of the visible universe to the Hubble radius is thus $\gtrsim 10^{32}$ times that of the Earth. This is quite a lot.

"I'll be late, I'll be late," growls the Lion. "3000 A.D. *already!"*

He bounds past without a glance. You frown—how impolite! After all, your g^{32}grandson owns vast tracts of territory on Suprasol—including this very game reserve.

The Lion turns round. "He's not that well-off, you know. I'm far richer."

You shrug. It's true. A million square kilometers is nothing on a suprastellar planet, even if much of it is on the prestigious level 3000. You hadn't realized it applied to lions, though.

"Not everyone chooses a human body," says the Lion. "Look at yours!"

You look down. You seem to be the Dormouse. You change into a plasma vortex and slip down below the inner shell, where a myriad transport loops festoon the interior; the sails of solar

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Date (AD)	Habitat Total/A^1_{Earth}	Area p.c./m^2	Biggest Area/A_{Earth}	Habitat Radius/km	Population Total	Population System[1]
2040	.005	2×10^4	.0008	160	1×10^{10}	1×10^8
2100	1.0	5×10^4	.05	1280	2×10^{10}	1×10^{10}
2130	3.5	7×10^4	0.2	2560	4×10^{10}	3×10^{10}
2160	13	1×10^5	0.6	2.5×10^4	8×10^{10}	6×10^{10}
2200	50	2×10^5	15	2.5×10^4	2×10^{11}	1×10^{11}
2220	100	4×10^5	17	2.6×10^4	3×10^{11}	1×10^{11}
2260	400	1×10^6	95	6.2×10^4	8×10^{11}	2×10^{11}
2290	1100	3×10^6	316	1.1×10^5	2×10^{12}	3×10^{11}
2500	1×10^6	2×10^8	3×10^5	3.7×10^6	2×10^{14}	3×10^{12}
2600	2×10^7	8×10^8	4×10^6	3.7×10^6	2×10^{15}	1×10^{13}
3000	5×10^9	3×10^9	3×10^9	3.8×10^6	2×10^{19}	1×10^{15}

(1) Population and habitat area in solar system, excluding Earth.

Table 1: Summary of populations and habitats with epoch.

windmills flash by at relativistic speeds, turning yellow sunlight to a red glow; and metal-rich streams boil up through plasma tubes from the deep sun, reaching above its blotched surface into space.

Now let's take a look at a scenario[10] for the construction of suprajovian and suprastellar planets within the Solar System (Table 1). It's an optimistic scenario, describing what we *could* do, not necessarily what we will—so don't take the details too seriously. At the same time it's a conservative scenario, excluding revolutionary technologies like molecular copiers and scientific advances as yet undreamt of.

2040 Terraforming of Venus[5] may begin, with aerial colonies there the first supramundane habitats. Population in space $\sim10^8$ in $\sim2.5\times10^{12}$ m^2 of space habitats at $\sim2.5\times10^4$ m^2 per person. Biggest habitat $\sim4\times10^{11}$ m^2, radius ~160 km. (I know this seems highly optimistic, but 50 years is a long time—oh, it might take two or three decades longer to reach this level, but I'll stick my neck out with this prediction.)

2100 Strong demand for materials from the outer planets may lead to the

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construction of the first supramundane habitats there[10]. Some may be of the simple aerial colony design[5], others may be supported by orbital rings.

2130 Biggest habitat is now $\sim 10^{14}$ m^2, radius ~2560 km, about the largest rotating space colony one can build efficiently with a diamond tosposphere. Hereafter we shall need to use suprajovians for the larger habitats, commencing at Uranus.

2160 Biggest habitat is now an equatorial strip ~2000 km wide around Uranus ($0.6A_{Earth}$), widening a strip habitat that may have commenced as early as 2050.

2200 Suprauranus ($15A_{Earth}$) and Venus terraforming ($1A_{Earth}$) completed. Work continues on other suprajovian habitats.

2220 Supraneptune ($17A_{Earth}$) completed.

2290 Suprajupiter ($316A_{Earth}$) completed. Emphasis moves towards large multi-layer and macaroni-loop rotating space colonies, then to suprasol habitats.

2500 Suprasol single layer ($3 \times 10^5 A_{Earth}$) completed. Large-scale mining of the Sun commences.

2600 Suprasol-12 completed with low mass layers, using mass dumping and solar power for mining. Hereafter we begin to use the Sun's internal heat to increase the mining rates.

3000 Suprasol-10^4 completes the 3×10^9 A_{Earth} Dyson Sphere. Habitable area of the fully tamed Solar System consists of the heavy suprasol planet (~60%); the suprajovians, Earth, Venus and the orbital habitats (~30%); and over 2,500 light-years of macaroni loop habitats along tramlines to the nearer stars (~10%). In all, there are $\sim 10^{18}/P$ solar systems with populations $\geq P$ at this epoch of *historical time*[12], down to a cut-off $P \sim 10^9$.

>3000 Suprastellar planets are completed in solar systems progressively further out. Radiator sink temperatures are gradually reduced to ~3K, increasing habitat areas by a factor ~100. Taming of the Galaxy continues.

And so as the clock ticks on towards 4000 A.D. *you lift away from Suprasol and out into the interstellar night, past stars whose very names are redolent of history . . . Alpha Centauri, Epsilon Eridani, Sirius, Tau Ceti—on through the teeming solar systems of the Sagittarius Arm, on to the heart stars of the Milky Way. There you behold the great world, layer upon layer around the galactic center, a million million million times the size of Earth. Downwards you sink, landscape after landscape flicking by, down through the innermost layer to plunge into the one-way shadow of the black hole beyond.*

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In the darkness you blink—then open your eyes again. The birthday tree lies before you; a red squirrel scampers up the smooth trunk. The linear sun slides out from behind a cloud.

Your great-granddaughter stands at your side. "Wake up, Grandest!" she says. "It's time for the party."■

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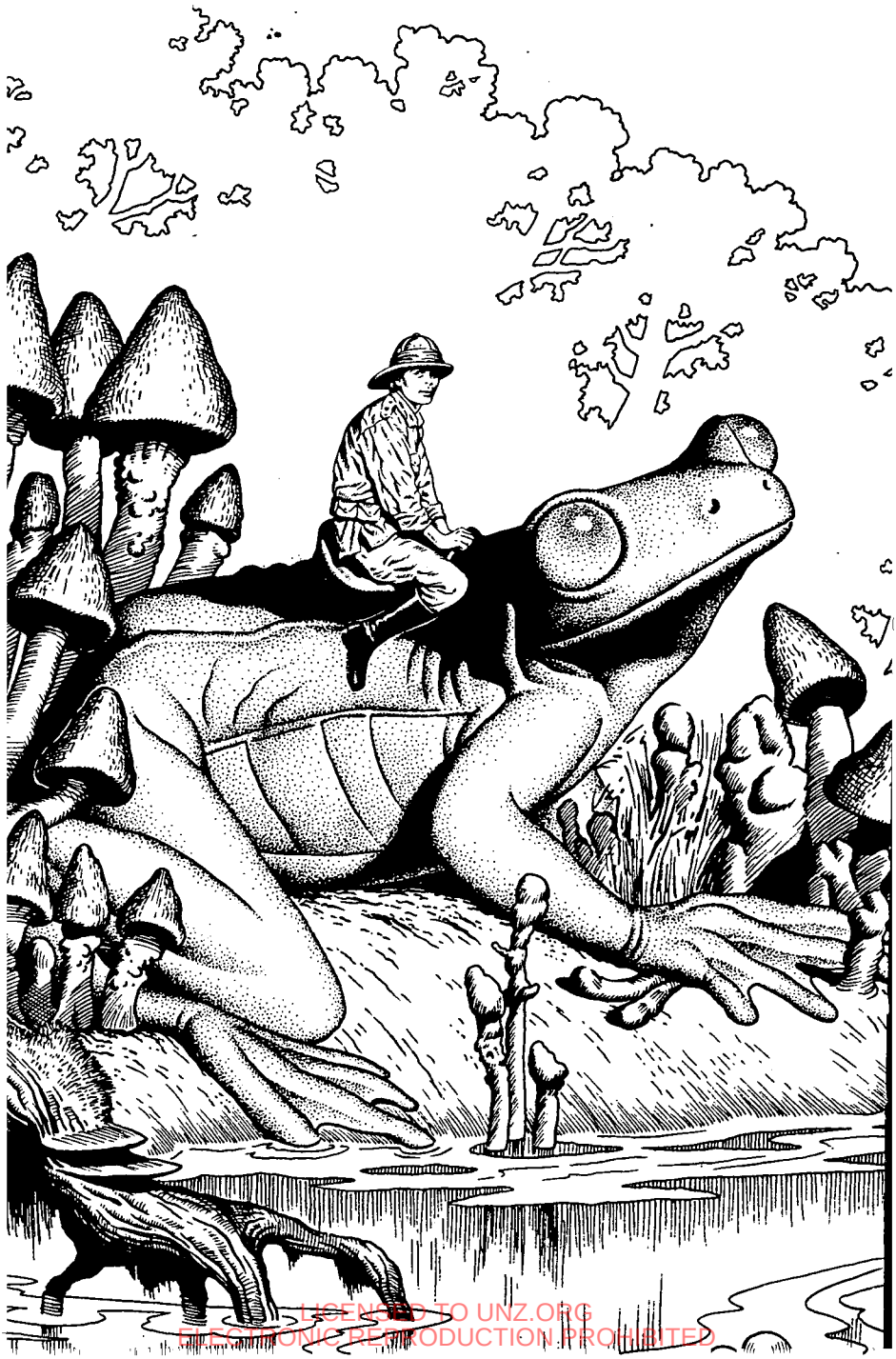

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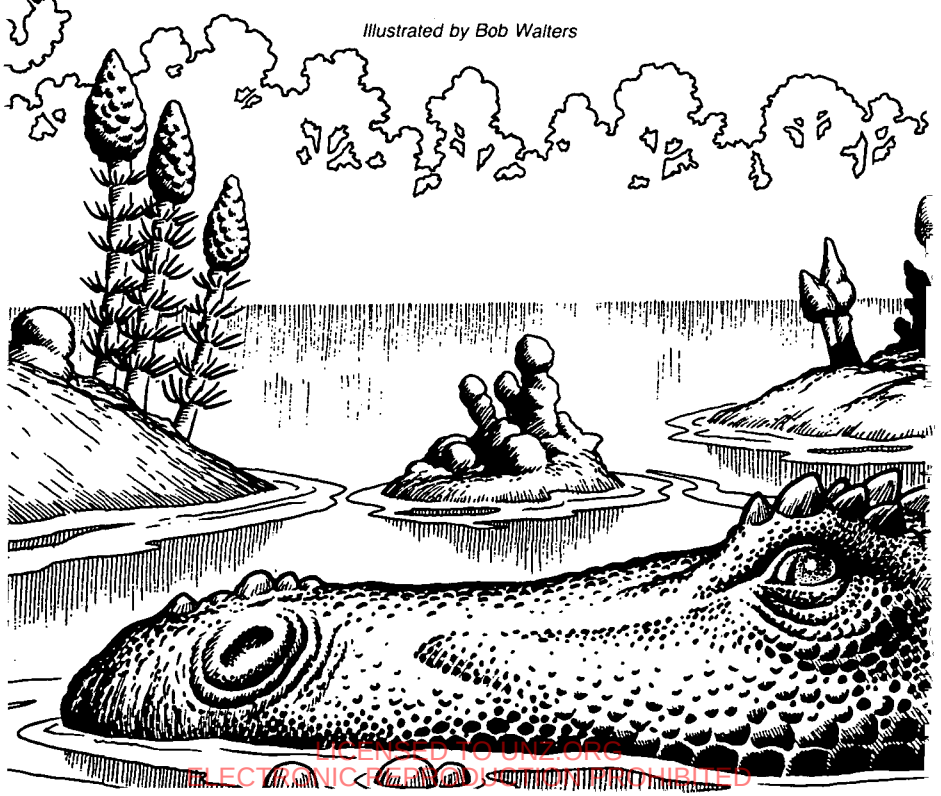
...AND HE DID RIDE

Rick Cook

Solving a big, long-range problem is likely to require, shall we say, subtlety. . . .

Illustrated by Bob Walters



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The ship floated above the blue-green bulk of the world, a tangled nest of jewels and light in the star-flecked void. A great city, tall and proud. James Peter Mackey stood on the lowest observation deck and watched the planet spin slowly beneath. There, where the North Continent trailed into the Tropic Ocean, lay the ugly gray-green splotch of the Great Gruesome Swamp.

And there, somewhere, lay his Doreen.

The Dark and Deliciously Fair Doreen—Mackey had coined the phrase and he was rather proud that it had taken hold—now lost and gone to the terrible world below.

Four days ago Doreen had gone with a surface skimming party to observe the Great Gruesome Swamp. Such expeditions were considered scandalous and thoroughly disapproved of by the older generation, which of course only made them all the more attractive to the younger.

Flighty, Mackey admitted to himself. *Decidedly flighty.* He bit the thought off guiltily. It was unbecoming to think that of his love so tragically lost in such a fashion.

No one was sure what had happened, but about the middle of the swamp the flier had crashed. A robot probe sent to survey the wreckage found no signs of human life.

And that was the end of it. Very sad to be sure, but there it was. No one on the ship had the least interest in pursuing the matter further. Oh, it would be a topic of poetry for some time, and perhaps a holoplay or two. It would certainly figure in the lectures the elders read their juniors on the folly of ignoring the wisdom of age.

But no one would lift a finger to look further for survivors.

No one except James Peter Mackey. Not a half-hour ago he had gone before the Council of Elders with a fiery plea for a full-scale robot search for Doreen and the others.

It had been a very fine speech, even if he did say so himself. It had been full of passion and fire and grief in judiciously blended proportion. Of course it had accomplished nothing. The elders listened politely, and he liked to think with some appreciation, but they had been unmoved. No expedition would be sent.

It was all monstrously unfair. The robots could easily be spared. The ship had plenty of manufacturing capacity and the robot mining vessels supplied raw materials from the system's asteroids and gas giants. Yet nearly a century after the end of the ship's generations-long flight, the elders insisted on citing a prohibition against wasting substance, a prohibition obviously intended to apply only while the ship was on its voyage through interstellar space.

Still, Mackey had done his best. Now he could devote himself to Doreen's memory with a clear conscience. That gave him a certain melancholy satisfaction. Pining for a tragically lost love fit him nicely.

Mackey's reverie was broken by a movement in the shadows.

"James. I knew you'd be here."

Sheri was small and blonde where Doreen had been tall and dark. She was accomplished in incense appreciation, adequate upon the hammered dulcimer, enthusiastic on the handball court and

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equally so in bed. Like Mackey, Doreen and most of their generation, she bore a name reflecting the last generation's fashion for the mid-20th century.

She came to stand beside him in the reflected glow of the planet. "I heard your speech," she told him breathlessly. "I thought it was wonderful. It should have moved them."

"I did my best." He looked down again and sighed deeply. For a moment both of them stared down at the cancerous splotch disfiguring the world's blue-and-white beauty.

"Do you really intend to go search yourself?"

"Huh?" said Mackey, shaken out of his thoughts.

"Are you going to search for her, like you told the elders?"

Vaguely Mackey remembered his final ringing declamation. It had been something about "no matter what course others may choose, I shall continue to bear the brand aloft, never resting until the last hope for the Dark and Deliciously Fair Doreen is forever extinguished." He had added it for rhetorical balance and now he realized that, taken literally, it did mean something.

"I would if I could," he said sadly, "but you heard the elders. I am forbidden."

"Oh," she said.

"What do you mean, 'oh'?"

"Just that, I thought . . . well, never mind. It wouldn't be prudent to go against the elders, would it?"

There was something in the way she stressed the word "prudent" that made it uncomfortably close to a dismissal.

In spite of his carefully nurtured poetic streak, Mackey was a rather serious-minded young man, which was sufficiently opposed to his image that any reference to it stung.

He reached out to her, but Sheri stepped away from him.

"I tried," he retorted. "No one can say I didn't."

"Of course you tried," she agreed. "You went as far as you could reasonably be expected to go." Then she turned toward the door.

"I'm not done, you know," Mackey said to her back. "I've got another stratagem to try."

The things one does for love, Mackey thought as he strode down the corridor. He couldn't leave the matter like this. Not if people like Sheri would think he was insincere in his love for Doreen.

Well, he would see. The elders had forbidden a search, but the elders did not control the ship. That was Sire Bonaventure's job. Sire Bonaventure was the artificial intelligence that had managed the ship in its 300-year voyage from Earth. The elders gave the orders and Sire Bonaventure carried them out. But everyone in the younger generation knew that while Sire Bonaventure would never directly disobey the Council, he might stretch his orders if asked properly.

The first problem, Mackey reflected, was coming up with a sufficiently clever request.

He didn't waste any time thinking about the second problem—which was that Sire Bonaventure was crazy.

Three hundred years of cosmic rays and stray malfunctions would take their toll on even the most robustly constructed computer, and Sire Bonaventure had apparently had some bugs from

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the very beginning. One result was that large parts of the computer's memory were simply unavailable. Another was that Sire Bonaventure was, well, eccentric.

One must admit he was an engaging eccentric, but even so. . . .

The Presence Chamber was decorated as an 18th-century drawing room, all white satin and old gold. All holos, of course, but appropriate because Sire Bonaventure always "wore" wildly archaic clothing.

As soon as Mackey stepped inside, Sire Bonaventure flashed into existence by the settee. He appeared as always, a sharp-featured old man, perhaps sixty, slender and elegant. Today he was wearing court costume complete with powdered wig, white satin knee breeches, and a coat of old rose brocade.

The image turned to him and raised a quizzing glass to his thin, aristocratic nose. "Ah, young Mackey, is it not?" Sire Bonaventure said. "How are you today?"

"Fine, thank you, Sire. Uh, but I need a favor."

Sire Bonaventure bowed elegantly. "Anything within reason, my dear boy."

"I want an expedition to search the Great Gruesome Swamp for Doreen."

Sire Bonaventure raised his glass. "I am not sure that falls within reason. There was some discussion on the Council, was there not?"

"They wouldn't do anything. That's why I came to you."

The image looked him slowly up and down.

"Is a search worthwhile? The scout robots found nothing."

"Maybe she survived the crash. Maybe she's still alive."

"My dear boy, whatever gave you that notion?"

"It's the dry season down there. The water levels are low."

"And so?"

"There's a chance. . . ."

"That someone survived? Doubtful."

"That I can at least recover her relics," Mackey snapped. "Something to remember her by."

Sire Bonaventure said nothing for a moment and Mackey was sure he had botched it. "Appropriately romantic," he said at last. "A fitting project for youth." He flicked his handkerchief. "Very well, I will assist you as best I may."

"Thank you!"

"However you will have to play a part, you know."

"Uh, what?"

"You will have to go down and search for her."

"But I thought—"

"That I could do it robotically? No, no, no, my dear boy, remember the elders' prohibition. I may not go against them, after all." He placed an elegantly manicured finger beside his nose. "But you, as a human being, have free will. If you choose to go and command me to help you, I must, within reason, obey."

"Uh, I couldn't order a robot search, could I?" Mackey asked half-hopefully.

Sire Bonaventure shook his head.

"You mean I actually have to go down there? Personally?"

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The image nodded. "And of course you must order me to support you in your expedition."

Suddenly Mackey's project had gotten a lot larger than he had bargained for. The prudent thing to do would be to abandon the idea now. But the memory of Doreen's laughing dark eyes drove him on—that and the knowledge he was publicly committed.

"Very well," he said sternly. "I order you to assist me in an expedition to the surface to rescue the Demoiselle Doreen!"

Sire Bonaventure made a graceful bow. "It shall be done."

Mackey strode from the audience chamber feeling excited, heroic, and apprehensive all at once. Also in the back of his mind was the faintest nagging suspicion that he had in some way been had, but he couldn't quite see how.

Three days later, resplendent in jodhpurs, safari shirt, and boots laced to the calf, James Peter Mackey swaggered into the engineering area to meet Sire Bonaventure.

He was very happy with the costume, he admitted as he stopped to admire his figure in a bit of brightwork. It was absolutely authentic, of course. His library research showed that this was what explorers on Old Earth wore to brave the dangers of unknown jungles. He had ordered the computer to search the complete files of *Weird Tales, Argosy, Doc Savage* and all the Tarzan books, and they all agreed on the point. Of course his trousers and shirt were clean and neatly pressed rather than artistically ragged as they were in the illustrations. But doubtless the rigors of the trackless jungle would quickly attend to that.

Idly he wondered how long it would take his skin to acquire that distinctive shade of bronze displayed by the men on the covers.

"Impressive," said a voice in his ear. Mackey jumped and turned and there was Sire Bonaventure, arrayed in slashed and puffed doublet of pale blue silk and parti-colored hose of cream and gold. "Yes," he agreed with himself, "very impressive indeed."

"Thank you," Mackey said, recovering his composure. "It is appropriate, I think."

"Completely," the apparition agreed. "But come. Your steed awaits," said Sire Bonaventure, bowing him into the workshop.

Mackey stepped through the door into the large open room, and saw for the first time the machine that would carry him through the Great Gruesome Swamp.

"It is specially designed, of course," Sire Bonaventure said, oblivious to Mackey's frozen stance and slack jaw. "A unique challenge, if I do say so, but I'm sure you will find the result most appropriate."

Mackey craned his head back to take it all in. The conveyance was perhaps twelve feet high and slightly longer. It was smoothly curved and carefully streamlined. Its alloy hide glinted golden.

It was also a frog.

"What am I to do with this?" Mackey asked dubiously looking at the creation in the middle of the room.

"Why, ride it, of course," Sire Bonaventure's voice hovered beside him.

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"It is the charger that will carry you into the Great Gruesome Swamp to find the Demoiselle Doreen."

"But it's a *frog!*" he protested.

"Well, my dear boy, you can't very well ride a horse into a swamp, now can you?"

"Well, yes, but . . . why a frog?" Mackey asked plaintively.

"What could be more appropriate for a swamp?"

"*Crooakk,*" said the frog, sounding like an unoiled door hinge.

Sire Bonaventure waved his handkerchief at his creation. "Philosophically it is quite simple. The first rule of good design is that form follows function. The second is that the forms of nature are both elegantly and subtly fitted to their places in the natural world. So to venture forth into a swamp, you need a conveyance modeled in the shape of a swamp creature." He frowned and cocked his head slightly. "I will admit I did consider using a crocodile, but a frog is much more elegant, don't you think?"

"I suppose I should be grateful you didn't come up with a turtle," Mackey said glumly.

"Oh no, no, no. A turtle simply wouldn't do. You need speed rather than armor, don't you know?"

Mackey walked around Sire Bonaventure's creation. "Where's the hatch?"

"Oh there is no hatch."

"Well, how do I get in?" he asked, eyeing the huge mouth dubiously.

"Oh no, my dear boy. You don't ride *in* him, you ride *on* him. There's a built-in saddle behind the head there—very tastefully concealed—and the reins attach to the rivets at each corner of the mouth."

"I thought I'd at least be inside."

"Not possible, you know. Bad design to have a frog with windows in his belly. Besides, there is no room. What with the fusion power pile, the armor, the actuators for the legs and the storage lockers, of course."

By now Mackey was totally bemused. "Storage lockers?" he asked, latching onto the last thing Sire Bonaventure had said.

"For your equipment, of course."

"Of course. Equipment?"

"Oh the usual explorer's paraphernalia. Ropes, camping gear, emergency locator, food." He coughed delicately. "And a body bag for the, ah, relics, naturally."

"Naturally," James said faintly.

"Now, you'll be taken down in a shuttle and deposited at the crash site. When you want to return, simply call and I will send a skimmer," Sire Bonaventure told him. *When you want to return*, Mackey thought. *Not when you find Doreen.*

"Very well, then, come along."

"I beg your pardon?"

"Why it's time to leave. Everything is ready."

"But I thought—"

"No time like the present, is there? Everything is loaded and you are already dressed. The shuttle is right through that door." He gestured and a large door in the other side of the laboratory swung open. Through it Mackey could see the padded interior of a shuttle.

Sire Bonaventure gestured again and the golden frog hopped forward and

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through the door. Mackey followed with Sire Bonaventure making little shooing motions behind him with his handkerchief.

It was work to herd the frog through the cargo hatch. Sire Bonaventure waved at him as the hatch dropped silently. "Goodbye, dear boy. Good luck and Godspeed." The last sight James Peter Mackey had of the ship where he had lived all his life was Sire Bonaventure's red-heeled shoes with diamond buckles.

Well, I wanted adventure, he thought to himself as the shuttle vibrated gently.

"Crooaakk," said the frog and blinked.

He tried to think of the Dark and Deliciously Fair Doreen but somehow he couldn't.

The shuttle was programmed not to exceed the limits of a human passenger. However the program assumed that the human would be seated and strapped in. The frog didn't shift in flight, but Mackey certainly did. By the time the shuttle's braking thrusters eased them to a landing, Mackey was shaken, bruised and very glad that the cargo compartment was padded.

The craft lurched to a halt, the door swung up, and James Peter Mackey got his first close-up look at the Great Gruesome Swamp.

It was not very prepossessing. The shuttle had landed on a muddy island that was barely three feet above the greasy green water at its highest point. The sky was an oppressive shade of gray, the island was a bare, black mud bank dotted here and there with clumps of unhealthy looking vegetation. Some of the plants looked like pond scum, some of them looked like bushes covered with pond scum, and some of them looked like trees made of pond scum. There was a faint, evil hum from the clouds of insects raised by the shuttle's landing that mingled with the sigh of the wind through the trees.

Worst, the place *stank*. It smelled of rotting vegetation and old mud and a dozen other things Mackey had never smelled before.

He stepped to the edge of the gangway and then tentatively put one foot onto the surface of a planet for the first time in his life. His boot squished in the mud to the upper. He lifted his foot out of the muck and eyed the result distastefully.

Well, best get on with it. He led the frog down the ramp and out into the mud. The golden robot provided the only spot of color anywhere in the dull landscape.

Mackey held the frog's reins and craned his neck while he considered the problem of mounting. There were no handholds or footholds anywhere on the frog's skin.

Perhaps if I . . . Something flew up Mackey's nose, tickling as it went. He inhaled to sneeze and drew in a mouthful of flying things too small to be seen. As he coughed and spit, he realized not all of the bugs knew he was immunized against them. Most of the insect things in the cloud over the island were ignoring him. Which was fortunate since at a rough estimate the visible insects outmassed him by about four to one.

"Crooaaak," said the frog, oblivious to the swarm.

"Easy for you to say," Mackey mut-

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tered through teeth clenched to keep out insects.

"Have we got any insect netting?" he demanded of his companion, remembering references in the old stories.

"Ribbet." A chest-high compartment popped open. There was a pith helmet complete with mosquito veil.

Mackey seized the topee gratefully and wound the netting around his neck. After four or five tries, he got it arranged so it kept out almost all the bugs.

Just as Mackey completed tucking the net into his sweat-soaked shirt the shuttle's klaxon went off in his ear. He jumped and nearly lost his footing in the slick mud.

CLEAR THE AREA, a mechanical voice roared. DEPARTURE IN FIVE MINUTES. CLEAR THE AREA.

No time to walk. He would have to ride the frog. Again he looked for a way to mount and found none.

"Kneel!" he commanded.

"Threedeep," responded the frog, and blinked.

"Sit! No, you're already doing that." The shuttle klaxon sounded again and Mackey grew frantic. "Uh, take me up. Stand by for boarders. Let me in. Open Sesame."

He ran around to the back of the frog and tried to climb the robot's sloping back. He got three feet up once and slipped off into the mud twice before he realized that the skin over the frog's "spine" was rough enough to provide footing. He scrambled up and settled himself into the saddle as the shuttle's turbopumps whined to life.

"Go!" Mackey shouted. The frog soared away in an enormous leap and Mackey nearly went off backwards. They were airborne just long enough for him to sense the ground rushing up to crush them and then he was slammed forward as the frog landed.

He was still rubbing his nose where it had hit the frog when the shuttle's engines lit up and the craft climbed into the clouds on a trail of sun-bright fire. He watched until even the flame from the shuttle's engines was lost in the grayness.

As the last faint glow disappeared James Peter Mackey realized he was completely alone on the planet. Just him and a mechanical frog.

"Wonderful," he muttered, swatting at an insect which had found a chink in his netting.

"Croak," said the frog.

He searched the island for nearly two hours but found no sign of Doreen. He did find the remains of the floater, though. The wreckage was strewn over most of the island. It looked as if something had been at it with a can opener. A very large can opener.

Mackey surveyed the remains of the skimmer and frowned. To date the robot scouts had identified twenty-six classes of large carnivores in the Great Gruesome Swamp. "Large" being defined as weighing a ton or more. The number of smaller kinds of carnivores was in the hundreds, plus the carnivorous plants and things that couldn't make up their minds whether they were plants or animals.

Then there were the scavengers, the poisonous plants and animals and the various large herbivores, who didn't usually mean you any harm but who would squash you into the mud quite by

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accident.

Off in the distance Mackey heard a roar. A dozen batlike things rose from their roost and flapped off into the swamp with whistling cries.

Mackey nudged a piece of the wreckage with the toe of his mud-caked boot. For the first time it occurred to him that danger was not only romantic, it could get him killed.

The sun was nearly on the horizon when he started to make camp for the night. One tip of the island was mostly sand. The sand tended to get into everything, but it was better than the oozy slime. He parked the frog, gathered a few waterlogged twigs, set them alight with a fuel tablet, and called the hissing, steaming stack a campfire.

The frog's entire outer surface seemed to be storage lockers. One of them yielded a blaster and gunbelt, which he strapped on proudly. Another contained a tent, another a sleeping bag, and still another food and cooking utensils, including an ironware coffeepot and a tin cup.

Feeling every inch the explorer, he drew water from the spigot on the frog's flank and poured the contents of a coffee pack into the coffeepot. While he waited for the mixture to boil, he pulled out a couple of ration packs and considered the problem of setting up his tent. After reading the instructions three times and thinking about it until the coffee boiled, he decided to sleep under the stars.

He picked up his tin cup, filled it to the brim with coffee and took a hefty swig, thus managing to burn his lips, tongue, throat, and fingers simultaneously. Through the heat Mackey realized the coffee was so bitter it curled his scorched tongue.

Perhaps if I let it cool, he thought and set the cup aside.

He settled on a log next to the fire and considered his options. First thing in the morning he would begin his real search for Doreen. The only thing was, he realized, he didn't have the faintest idea where to look. Dead or alive, Doreen obviously wasn't on the island.

After several minutes of pondering he tried the coffee again, carefully sipping the lukewarm brew from the tin cup. Now it was cool and impossibly bitter. Mackey decided he hated coffee.

He could run a spiral search starting from the crash site, but half the spiral would be through deep water with no islands. It wasn't likely he'd find anything there.

The alternative was to backtrack beneath the floater's flight path on the chance that Doreen had been thrown free before the actual crash. But if that had happened she probably would have fallen hundreds of feet.

This wasn't very hopeful, he admitted to himself. Glumly Mackey looked out over the swamp. His fire cast highlights onto the black surface of the water, little glints of yellow and red stretching out onto the darkness in a single long river.

No, Mackey realized, not entirely in a single river. Off to one side there were two glowing coals perhaps a yard apart.

He looked back to the fire and over to his mechanical companion.

The frog just wasn't working out well at all. Poor design, obviously. He'd have to speak to Sire Bonaventure about that when he returned to the ship. He

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sighed and turned to look again over the oily water.

There was still the highway of glints out into the darkness and the two glowing coals a yard or a yard and a-half apart.

A yard and a-half apart and getting closer!

With a mighty splash a 50-foot long crocodilelike thing charged out of the swamp, slavering jaws agape. Before Mackey could move it was upon him. Before he could even begin to be frightened it knocked him aside and attacked the biggest prey on the island—the frog.

"Ribbet."

It was not a very satisfactory attack. For one thing the frog was heavier than it looked and could not be overset. For another the robot's armored hide was impervious to the creature's teeth. But worst of all, the frog wouldn't fight back. It just sat there while the panzergator charged, bit, and clawed it, roaring challenges all the while.

"Threedeep."

Mackey cowered behind a convenient log, covered his ears and tried to make himself invisible.

With a final disgusted lash of its spined and armored tail the thing turned from the frog and slithered back into the water without a splash and with hardly a ripple.

Ears ringing, Mackey looked around. His fire was scattered, his coffee pot overturned and flattened, and most of his supplies strewn across the camp site.

Shining his belt light around, Mackey saw that one of the ration packs had landed intact under a particularly bedraggled bush a few feet behind the frog.

Mackey reached for the ration pack. The plant rattled its leaves and hissed at him. Mackey decided he wasn't hungry after all.

He spent the rest of the night in a tree and got no sleep whatsoever.

About dawn small crawling things came out of crevices in the tree bark to go about their business and began to slither over Mackey like he wasn't there. But sometime between the panzergator's attack and the first slither Mackey had come to a decision.

I'm not going back, he thought. *Not until I've really searched for Doreen!*

It was not, he admitted, a completely logical decision. It might have been the result of hunger, fatigue, or perhaps the bite of some psychedelic insect. But somehow it felt right. Mackey had always been stubborn and he wasn't going to let this planet defeat him, no matter what!

Something very large splashed in the water beyond the veil of morning fog.

Of course, he thought, *there's no sense in taking this to extremes. A couple of days will be plenty to satisfy honor.*

Riding the frog at the hop wasn't so bad, Mackey found. Or at least it was possible if you stood up in the stirrups and kept your knees flexed. By midmorning they were well away from the island and Mackey's thighs and calves were killing him.

Where there was footing beneath and clearance above the frog traveled by hopping. Mackey learned the hard way that the frog's idea of clearance was pretty liberal. Twice he had to hug the

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robot's back to avoid being swept off by a low-hanging tree limb.

When the frog couldn't hop, it swam. Its swimming position kept Mackey's boots inches above the water. That was more comfortable than hopping but remembering the horror that had come charging out of the water the night before, Mackey decided he preferred hopping.

Mid-morning found them on another mud island and he reined to a halt to check his map. As he stood in the saddle and tried to match the mostly featureless swamp with the mostly featureless map, he saw a flock of large birdlike things making an untidy V through the cloudy sky.

Scavengers, Mackey thought, recalling his indoctrination. *They live mostly on the leavings of the large carnivores. They also groom parasites off the big meat eaters.*

The beasts were closer now, wheeling purposefully over them.

Groom parasites . . . Oh dear!

The first scavenger peeled off and dove, obviously intent on plucking this strange parasite off the back of this equally strange animal.

Mackey ducked at the last minute and the beast's talons only raked his back, leaving deep, painful scratches.

The frog's head swiveled and its tongue shot out, knocking the animal out of the air. Too quick to follow the tongue retracted and lashed out again, knocking another flier into the water.

Deciding their services were not desired, the animals went hooting off into the forest.

There was a large splash as something grabbed the downed flyer and dragged it under. Then there was silence.

Looking at the fading ripples in the water, James Peter Mackey came to another decision.

Jesus Christ I hate this place!

That opinion hadn't changed a week later when Mackey decided to pack it in. He was bright red from sunburn, spotted with bug bites, scratched in a hundred places, and nursing a nasty collection of cuts and bruises. His shirt was long since reduced to rags and his boots were rotting on his feet under the attack of various fungi. He wore them unlaced for comfort. The sole of one was tied on with a spare shoelace.

He had also developed a permanent twitch and a tendency to cower at loud noises.

He had managed to come barely twenty miles and now he was approching one of the densest parts of the Great Gruesome Swamp. The gray-green vegetation loomed out of the oily water in front of him like a solid wall. That would be nearly impenetrable even for the frog. And if they could force through it he wouldn't be able to see more than a few feet in any direction.

Mackey pulled his field glasses from their rotting case and scanned the jungle's face looking for a break in the wall. There was none to be seen in either direction—which only confirmed what his maps told him.

He sighed and started to lower the glasses. Then a flash of white in the tops of the trees caught his eye. Eagerly he raised the binoculars again.

But it was only a place where some of the top branches had broken off,

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exposing the pale wood beneath the dull bark.

In fact, it was a place where a *lot* of branches had been broken off. As if something large and heavy had forced its way through the very treetops recently.

Large and heavy and moving very fast.

Mackey yanked on the frog's reins and dug his heels into the sensor pads on the robot's metal flanks. The frog's hind legs shot out in powerful kicks that drove them through the water so fast the spray soaked Mackey from battered pith helmet to rotting boots.

The treetops had definitely been broken down, Mackey saw as they got closer. And whatever it was had been coming away from the forest and toward the crash site, judging by the way the splintered tops lay. He rose in the saddle and looked harder.

"James! Here James!" There, up in the tree, was Doreen. She was dirty, disheveled, and wearing mostly rags. Her dark hair was filthy and matted and she had an ugly red cut over one eye. But she was still the most beautiful thing he had ever seen.

Mackey kneed the frog in closer to the trees. As soon as he could, he reached out, grabbed a branch, and started to climb. Above him Doreen was laughing and crying and calling his name all at once.

She climbed down as he climbed up and they met fifty feet off the water, Mackey clinging precariously to a branch and Doreen clinging tightly to him.

"Oh you came. You came. Oh my God."

Mackey shifted Doreen to his left arm and clawed at his belt for his communicator.

"I've found her. Now get us out of here!"

Once again James Peter Mackey stood on the observation deck and looked down on the planet. The ugly splotch of the Great Gruesome Swamp was creeping beneath the terminator and disappearing into the darkness. Over the blue sea storm clouds were building in a swirl of brilliant white, threatening to lash the coast and the swamp with the first storm of the season.

Mackey took it all in and tried to disentangle his feelings from his suspicions. There was a party going on two levels above with him and Doreen as the guests of honor and the giant metal frog as the centerpiece. If he didn't leave soon he would be more than fashionably late. But none of that seemed important just now.

Deliberately Mackey turned his back on the world below and spoke into empty air.

"I want to talk to you."

"Yes, I rather expected you might," came a voice in his ear. Mackey whirled and there stood Sire Bonaventure, dressed in smallclothes of palest blue trimmed in silver lace.

For a moment man and holo eyed each other; the holo all smiling benignity and the man—well he wasn't sure.

"I spoke to Sheri last night," Mackey said without preamble, "about our meeting the day I made my speech to the elders. She didn't know what I was talking about."

"The young lady does have a rather

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poor memory," Sire Bonaventure observed pleasantly.

"She also wasn't here."

Sire Bonaventure frowned in distress. "But how can that be if you talked to her?"

"Easy. I didn't talk to her. I talked to something that looked like her. A holo. Like you."

The image arched a delicate eyebrow and said nothing.

"It's dark here. As long as I didn't touch her and she didn't stand in front of a light, I'd never know it wasn't Sheri."

"But my dear boy, why ever would someone play such a knavish trick on you?"

"Not someone," Mackey grated. "Some*thing*. You."

"Me? But why?"

"Because you wanted to make damn sure I came to you for help. So you could dump me down on the damn surface with your damn frog."

Sire Bonaventure produced a handkerchief from his sleeve. "An interesting notion, surely."

"I've been putting things together since I got back." Mackey charged on. "For one thing, I don't think you're nearly as crazy as you're supposed to be."

"One should never go by popular report," Sire Bonaventure agreed amiably.

"Then I thought of those books. *The Scarlet Pimpernel, Sword of Zorro*, and the rest where someone posed as a fop to cover his real motives."

"Appropriate for youthful romance."

"And for someone who wants to cover himself—human or not," Mackey said.

"What are you suggesting?"

"That this is all an act. Those clothes, your manner. They're all assumed to hide your real purpose."

"Which is what? To rescue French aristocrats from the guillotine?"

Mackey opened his mouth. Then he realized he didn't have the faintest idea what Sire Bonaventure was up to. He also realized he didn't really care.

"All right," he said just a shade too calmly. "I want to know why."

"Why?"

"*WHY*," James Peter Mackey roared, "*THE HELL DID YOU SEND ME INTO THAT SWAMP ON A GOD-DAMN FROG?*"

Sire Bonaventure neither blanched nor changed his posture.

"Oh, but my dear boy, it really was the best I could do for you. I am damaged, you know."

"Excrement. You just told me you weren't."

"Did I? If you review our conversation you will see that I told you I was not as damaged as popular report supposes. No, no I forgive you," he said, waving a hand graciously to acknowledge an apology Mackey had no intention of uttering. "You are after all overwrought and full of the rashness of youth."

"One more time," Mackey ground out through clenched teeth, "why?"

"Why the frog? But I told you—"

"Fornicate the frog! Why did you send me down there?"

"My dear boy, I didn't *send* you anyplace, I merely—"

"Egged me on," Mackey cut in, "helped me, supplied me, encouraged me in a crack-brained scheme that

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nearly got me killed a dozen times over. Now why?"

Sire Bonaventure hesitated and then nodded. "A fair question. Very well. Why are we here?"

"I beg your pardon?"

"Why are we here?" Sire Bonaventure repeated sharply. "Why did we leave Earth?"

"To travel, of course. To see new worlds."

"Three hundred years is a trifle far for a tourist excursion," the image said dryly.

"Well, call it exploring."

"To explore yes, but also to colonize."

Mackey blinked. "Colonize?"

"That is, after all," Sire Bonaventure said waving his handkerchief toward the planet below, "the Earth-like world nearest to Earth itself."

"You mean live down there?" Mackey said, horrified.

"But of course. Oh not in the swamp, but on the surface of the planet. I can assure you there are many places much more salubrious."

Mackey looked out the window at the planet which had nearly killed him and shuddered. "That's the most awful thing I can imagine."

"That is to be expected. After all you come from a culture which is totally unsuited to colonization."

"If we're so unsuited why were we sent out here? Why not pioneers or something?"

"My dear boy, we faced a 300-year voyage. Generations in space. One would hardly care to be confined with a band of pioneers for generations, now would one? No, we needed a more mannered society. One which would be content to work on a smaller canvas, untroubled by its own insularity.

"I know I was supposed to change that when we arrived, but I seem to have forgotten how." He paused, handkerchief motionless. "I seem to have forgotten how," he repeated softly.

For a fleeting instant a look of real pain crossed Sire Bonaventure's face. In spite of his anger Mackey felt a touch of pity for this so-familiar yet so-strange intelligence who shared the ship with the humans.

"In any event," the image went on briskly. "When one's plans are overset, one must improvise. Under the circumstances, I think I have contrived rather well."

"You mean you manipulated us."

Sire Bonaventure went on as if he hadn't heard. "I may advise, I may suggest. I may even scheme. But except under the most extreme circumstances I may not command. The builders had a fear of what they called a Frankenstein complex." He sniffed dismissingly. "In any event, ordering humans about is seldom effective. You are a *most* contrary species, you know."

"So you set me up."

"Oh I admit I had little hope for the young lady's survival. But considering your psychological profile and your public attachment to her, I saw the situation as fortuitous."

Mackey was beginning to wonder if Sire Bonaventure's "fortuitous" accident had been an accident at all. But he didn't say so.

"So I encouraged you nonetheless," the AI went on. "It was a way of getting someone to actually go down and walk

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the surface of the planet. A beginning on our real mission, you see."

Mackey thought of all the young men who were determined now to have adventures of their own down on the surface. It was working, he admitted. It was a beginning.

"And moreover," Sire Bonaventure said, "your adventures have made you a hero and won you the fair Doreen."

"Yeah. Well, that's the other thing."

"Dear me, do I detect a note of discontent?"

Mackey shifted from one foot to the other. "It isn't at all what I thought it would be. Oh, I get to swagger around and brag and be admired but . . ." he paused and frowned, groping for words, "well, it's so *artificial* somehow. No one wants to hear about how frightened I was or how uncomfortable."

"Of course not. You're a hero and such emotions are unbecoming to a hero." Sire Bonaventure looked him up and down. "You do play the role rather well, you know."

"Maybe. But's it's not what I imagined."

"It never is," Sire Bonaventure murmured, inspecting his nails. "I trust, however, that at least the young lady is appropriately grateful?"

"All she wants to do is hang all over me and cry on my lapel. She's grateful, but, well . . ."

"But it isn't instant, undying love? Perhaps that takes some more time."

"It's ruining the lapels of my suits," Mackey said tartly. "Since we got back she's turned into a watering pot."

Sire Bonaventure placed his handkerchief to his nose. "That is the appropriate behavior for rescued females, is it not? She has a role to play just as much as you. Perhaps privately she finds it equally onerous."

"Anyway, it doesn't seem worth much," he said dully.

"That is rather the nature of heroism," Sire Bonaventure agreed. "Perhaps that is why humans find the tragedy of unfulfilled desires so much more interesting."

Mackey's shoulders slumped. "I guess."

"Now do not underrate your accomplishments," the AI admonished. "You are perhaps the only one of your generation with the courage to persevere even after you discovered just how inhospitable the swamp was. And hero or not, you have won the fair lady."

Mackey snorted. "And she turns out to be as hysterical as she is beautiful."

"I would especially advise you to reconsider that last," Sire Bonaventure said sharply. "There is a brain under those raven tresses and steel beneath that gown besides."

"What makes you so sure? Have you been spying on her too?"

"I don't have to. And if you could think beyond appearances, neither would you." Sire Bonaventure waved his handkerchief at the planet below. "My dear boy, could *you* have survived unaided in that swamp for fourteen days?" ■

●A reasonable probability is the only certainty.
Edgar Watson Howe

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THE ALTERNATE VIEW G. Harry Stine

WHERE ARE THE REAL ENGINEERS?

Recently, I've been involved as a consultant on an engineering project. I'd prefer not to mention names because this column is likely to get a little rough on some of the people I worked with. In any event, the purpose of this column isn't to point fingers but to reveal a disturbing trend. Maybe something can be done about it.

The goal of the project was to build something and test it. The device didn't exist, although a lot of studies and many technical papers have been written about it in the last 40 years. The first goal was to design, build, and operate a proof-of-principle prototype. This would be a cheap-and-dirty off-performance piece of ironmongery using off-the-shelf technology and hardware. It would be used to check out some of the questionable approaches to the solution, find out if the approach was really workable, discover the items that are always overlooked even in the best designs, and then allow the company to proceed with the pre-production device with a higher degree of confidence and a lowered level of risk.

Furthermore, it had to be done on a total budget that was embarrassingly low and on a time schedule that was impossibly short.

Briefly, this approach is standard, old-hat, everyday engineering that you use when you're trying to do something new and different.

No big deal, right?

Wrong!

In this particular industry, no one had been allowed to make a mistake in the last 30 years. Everything had to work perfectly the first time. Everything had to be a success when the switch was flipped or the button pushed.

It has been a fascinating experience to watch the way both experienced old-time engineers (who are now managers) and fresh-caught engineers tackled the project.

The old-time engineers had to battle two decades of on-the-job experience. Tattooed on their brains was the dictum: "Thou shalt not fail, it must work the first time, and thou hast no room for error."

Well, that attitude can be handled because these older engineers remember the time when it wasn't that way. It's not too difficult for them to shift mental gears and get back to the old method

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that amounts to: "Well, hell, let's just whomp up a boilerplate test model of this puppy and see if it passes the smoke test when we plug it in!" That's what engineering used to be all about, and it's one of the factors that made it fun.

Engineering used to operate on the principle, *"Experience gained is directly proportional to the amount of equipment ruined."*

Then you could forge ahead to design and build stuff that wouldn't bust. Prototypes weren't worth a damn unless you busted them. Otherwise, you'd underestimated yourself and didn't need the prototypes at all.

Once that ancient principle was reestablished in the minds of engineering management, the project became fun. But it didn't make it any less stressful. The lack of big money and the short deadlines kept the pressure on. I could see the gradual metamorphosis of the older engineers (of which "I are one," too).

The real problem came with the young engineers who had recently (within the last ten years) received their engineering degrees. The young engineers were brilliant when it came to design work. They knew how to run computer analyses until the floor was covered with printouts. They were whizzes with CAD.

But they had never "bent tin."

They had never been responsible for designing something that could be built and was supposed to do something.

This puzzled me at first. Then I figured out what had happened.

Fifteen years ago, my son decided he wanted to be an engineer so he could become a product designer. So we went to several colleges and universities to see what their engineering curricula, facilities, and teaching staff amounted to.

Turns out that something had changed in Engine School.

Two career paths existed (and still exist) for engineers.

An engineering degree now consists of an extremely strong emphasis on scientific theory, mathematics, and computer technology. *And practically no hands-on lab work!* The venerated engineering degree has been converted into a degree in applied science!

On the other hand was the path leading to a bachelor's degree in "engineering technology." Upon close investigation, I discovered that this poor stepchild of modern undergraduate study was indeed the sort of hands-on, practical engineering curriculum that I was familiar with back at mid-century. But it no longer turned out "engineers." It graduated lowly "engineering technologists."

Aha! No wonder that some of the modern products of engineering seemed to be less-than-elegant in their design, construction, and operation! They have, essentially, been designed by scientists, not engineers! The real grubby-handed engineers, now called "engineering technologists," have come along after the "engineers" are finished. The engineering technologists are the ones who have had to make the damned product work after the design has been approved!

(I have nothing against scientists. In fact, my degree is in physics, not engineering. Scientists are needed to explain why something works after the inventor

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conceives it and the engineers make it work. Yes, some modern products have sprung from the science lab. But far more of them have come from inventors.)

Robert A. Heinlein, an engineer himself as well as an eminently practical scientist, put it very well in *The Rolling Stones* in 1952: "Fiddle with finicky figures for months on end—and what have you got? A repair dock. Or a stamping mill. And who cares?" Hazel Stone missed one of the existential joys of engineering: Pride in making it work the way it's supposed to.

Dr. Wernher von Braun was one of the best real engineers I've ever known. I saw him do engineering right out on the test stands with the technicians. When I read his biography, I understood why.

Von Braun studied at the Charlottenburg Institute of Technology, Germany's equivalent of MIT and Cal Tech. As part of his education, he was apprenticed to the Borsig Werk. There, an old foreman handed him a chunk of iron about as large as a child's head. He also gave von Braun a file and pointed to a bench vise. He was told, "Here are your tools. Make this into a perfect cube. Make every angle a right angle, every face perfectly flat and smooth, and every side equal."

Five weeks later, von Braun had filed the chunk of iron into the required perfect cube that had become the size of a walnut. *But size had not been specified!* Borsig then put him to work on a lathe, on a shaper, in the foundry, in the forge, and finally in the locomotive assembly sheds. Von Braun later recalled that he had gotten more insight into practical engineering during that apprenticeship period than he had in any semester in the university.

Today, von Braun would have received a degree in engineering technology, not engineering.

And the engineers involved today in the project I used as a nameless example are learning the hard way what engineers used to learn in undergraduate work and their first few years in the field. They're having to bend tin against a schedule. They are having to make do with what they can get off the shelf. They don't have one thin dime for R&D. They are learning to read Thomas' Register. They are learning how to scrounge through junk yards to find something cheap that will do the job. They are facing a world where good enough is the enemy of the best, where an adequate solution today is far more important than a perfect solution tomorrow.

I'm convinced both the old hands and the young pups will do just fine on the project. I expect them to destroy the prototypes but also to learn from that. And they are going to come out of the project as one of the best damned engineering teams in the industry. The company they work for has a long and proud history of building gadgets that work, make money for the company and the customer, and stay in service for decades. I won't have to tell you who they are; you will know.

Now, what are we going to do about this dichotomy of engineers and engineering technologists?

If I wanted again the challenge of putting together an engineering team to do

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things, I think I'd be partial to hiring engineering technologists. One of our problems in the United States is our penchant to study things to death before risking our careers on the real possibility of a failure, regardless whether it's an engineering job or a business deal. Yes, we've got to use our resources wisely and do our best to succeed rather than fail. But we've been studying things too much. Time to build and bust some prototypes.

We've *got* to stop studying things to death. We've *got* to be willing to bust prototypes. We have to get out there in the world, make things that work, and *produce them!*

I have a friendly controversy going on with Arthur C. Clarke, whom I've known for more than 40 years. I keep telling him, "Arthur, we aren't all going to sit around in front of our computer terminals being creative and communicating with one another in the global village. Someone is still going to have to milk the cows!" (Or attach, remove, clean, and repair the milking machines.)

Another friend of mine, L. Sprague de Camp, begins his excellent book, *The Ancient Engineers*, thusly:

"Civilization, as we know it today, owes its existence to the engineers. These are the men who, down the long centuries, have learned to exploit the properties of matter and the sources of power for the benefit of mankind."

We don't need to educate more scientists in America. We need more engineers. I think it's time we ended the experiment of calling educated applied scientists "engineers" and transitioned back to what we know works: Educating more grubby-handed "engineers with hairy ears and long and woolly britches," as the old and unprintable ditty goes.

Maybe we also need to adopt the European custom of permitting a real engineer to place before his/her name the honorific, "Ing."

Then turn them loose to continue changing the world as they have for centuries. ■

●If you want to make enemies, try to change something.

Woodrow Wilson

●Creativity varies inversely with the number of cooks involved in the broth.

Bernice Fitz-Gibbon

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Murder is not unknown among the starfaring species comprising the Confraternity. The Rhengizzks are openly and ferociously bloodthirsty among their own kind. And several races routinely conduct ritual murder of interlopers or outsiders in their midst. But interspecies murder is, on the whole, very rare, as the freedom of individuals within time and space and the lack of meaningful cultural friction points make it difficult to develop credible motives.

The unusual threat of such a murder, was what brought me to an uneasy position in a refreshment center, called a cocktail lounge by the locals, on the planet Earth.

It was late afternoon. A small herd of businessmen sat in a corner booth, quietly grazing on martinis. Three or four native patrons sat on stools around the periphery of the bar as the bartender occupied himself cleaning empty glasses. I was the only non-native present, but such was not the cause of my uneasiness.

My first source of discomfort was the danger of maladjusting myself on a bit of alien furniture called a stool as I waited for the human I was to meet, Bantam Brewster.

Perhaps I should explain that a "stool" is a meta-unstable furnishing, a pillar rising from a floor and topped by a circular platform which rotates at the least twinge or reallocation of body mass. In the instance at hand, I grasped the brass rail encircling the bar with my lower pair of tentacles in a wobbly but successful effort to maintain my balance.

[I beg the intelligence's indulgence as it absorbs this account. In the tradition of *kthsprli*, I record this in the local manner and idiom, in this case English—an oral/written language used with equal status and preference in social negotiations, commerce, theological debates, and scientific inquiry. This most peculiar style works passably well for the natives. Most of the time. I will try to refrain from explaining Earth's many oddities, leaving to the intelligence the task of extracting the meaning of terms from context.]

In addition to grappling with the alien furniture, I was uneasy with the environment. Ordinarily I do not mingle quite so closely with natives, particularly when involved with activities covered by taboos of my own culture, such as eating and drinking. But a curt note delivered by courier from a Mr. Sandhurst of the Confraternity-Earth liaison office had specified this as a meeting place and, having no way to contact Bantam Brewster beforehand, I had little choice but to accede to Sandhurst's request.

But any unease I may have felt was more than compensated by the potential good accruing to me. For in the situation I saw the possibility of a story that would re-obtain the satisfactory regard of my editor and get me off the most recently discovered—and very miserable—planet called Earth. And so I clung to my stool, observing human behavior, hoping that Brewster would show up soon.

"Do you want another?"

I waved my cluster of eye stalks back and forth to signify assent to the bartender. My species shares with humans a group of reactions to a fairly wide range of pharmaceuticals, including al-

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cohol, our gross differences of external physiology notwithstanding. Moments later, another Scotch on the rocks was placed before me and I used one tentacle to slide a credit chip from my carrying pouch. I spread my eye stalks to regard it from half a dozen vantage points, then clutched the glass to my mid-section so that my tongue could suck its contents as I contemplated the denizens of the bar. Eavesdropping, actually.

Humans are peculiar in that individuals variously exhibit social/emotional characteristics of herd grazers, pack predators, solo raptors, and even vegetables. Moreover, some individuals' characteristics vary depending on the social context of the moment. In the instance at tentacle tip, the herd of businessmen were engaged in reaffirming the values of the herd ("Woo! Did you get a load of that new receptionist?") while establishing pecking order within the herd hierarchy (". . . scored a cool half-mil in commissions last quarter . . ."). Intent as I was upon studying the herd dynamics, I didn't sense the human who came up behind me.

"You must be Ace Berkley."

I twisted a pair of eye stalks to regard the speaker, a stocky human male with a florid complexion. [Humans are divided into two sexes, with distinctions between the two scarcely noticeable to a non-human observer, but forming the basis for a significant portion of human social discussion. Relations between the sexes are simultaneously adversarial and cooperative, a condition which even humans can not satisfactorily explain.]

"Yes, I'm Ace."

Brewster raised an eyebrow. "You speak English pretty well for a Celery. Most aylees don't try it without a speech-a-coder."

Had I been human, I would have nodded my head, but lacking such a concentration of sense organs, I waved my eye stalks.

"It's part of my job," I replied. "I'm trained to absorb native cultures on at least a superficial level. Can't be a good *kthsprli* without it."

"Journalist, you mean."

"The translation is close enough, though lacking in nuance."

Brewster reached out and tapped my glass with a pseudo-tentacle. "On the rocks, huh? Just like my first three marriages."

The meaning eluded me; Brewster shifted the loosened knot of his paisley necktie back and forth for a moment. This activity made no difference, for the tie was far too small to adequately cover the wrinkles of his torso garment.

"Yeah, nuance. Sure," he continued. "Anyway, I hear you *kthsprli* are real great at putting together information. Information from all sides of a problem, whether from unruly natives or factions within the Confraternity development assistance agencies, right?"

I wiggled my eye stalks. "To truly absorb a story . . ." I left the statement unfinished.

Brewster waited several moments. Unlike most humans, he viewed my eye stalks with no trace of unease. "And a truly absorbing story will get you off this planet you dislike so much," he said evenly.

As a *kthsprli* I respect the ability to gather information. That Brewster knew of my predicament spoke well for his

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abilities. Perhaps too well. I squirmed on my bar stool.

"Just how did you get stuck here?"

"I was late transmitting a *ktharng* detailing the social evolutionary problems of one of the younger races of the Confraternity."

Brewster grinned, very much a raptor toying with his prey. "Blew a deadline, huh? By how much?"

I considered briefly. "The time required for your species to build your first more or less permanent settlements until now."

"Sweet Jesus! *How* long—"

"About ten thousand years as you reckon it."

Brewster muttered something; briefly I saw a mental image of a vast expanse of darkness, with bright tiny lights flickering on for a moment before being extinguished for good, while other, duller lights continued to shine forever. I understood.

"It is not quite as you think, Bantam Brewster. The subjective time is much, much shorter, due to gross relativistic effects of space travel. Our lives have a greater intrinsic span than yours, which is only natural, given our ability to edit out genetic errors that creep into the cellular reproduction process. But our life spans are not much more than ten times greater than yours, from the viewpoint of subjective experience."

Brewster's eyes flickered. His mouth opened, then shut. "Mind reader," he muttered.

Then he grinned the grin of a feral hunter again. "In that case, Ace, if one of you Celeries gets murdered, you lose not much more than ten times as much as one of us do."

* * *

"You said you have some details," I said. Having left the cocktail lounge in the Century City portion of West Los Angeles, we sat in Brewster's automobile, creeping along the Santa Monica Freeway toward downtown during evening rush hour. Even creeping along, we were lucky. The traffic coming *from* downtown had completely halted. I found myself hoping that the Confraternity engineering staff would address the problem soon.

"Yeah, sure, sure," said Brewster, edging his car from one lane to another. "Guy who put me in touch with you and hired me, McLean Sandhurst, works for the UN commission for technology transfer. That's the agency that oversees the Confraternity assistance to Earth. Specifically, he's working on the programs to make Venus and Mars fit for human habitation and on genetic-based life extension."

"Yes. Very large tasks." Even using Confraternity assets and technology, it would take nearly an Earth century to completely transform Earth's two sister planets. As for extending human life spans, I myself had doubts about the utility of the proposal, given the low quality of life on this world anyway.

"There's this organization called Save First World Association."

"Of it I am aware."

"Yeah, well, SFWA is an odd assortment of people. They oppose the aylee technical efforts for a variety of reasons—economic, environmental, and political—mainly boiling down to the belief that we should solve our own problems ourselves."

"A not uncommon sentiment ex-

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pressed within many amok cultures being assimilated into the Confraternity."

Brewster was silent for a long moment, scowling and checking his rearview mirror as he changed lanes once more. "Yeah, well you see, a lot of us don't like being assimilated into anything, even if it does mean the Moon, and the stars, and all the planets."

That, too, was a common sentiment, but I refrained noting this to Brewster. "So what does SFWA have to do with murder?"

Brewster abruptly turned his steering wheel to cross two lanes and turn the car down a freeway exit ramp to the accompaniment of a blaring truck horn. "Nothing, up to now. But this guy, Sandhurst, got two anonymous threats that boil down to, 'Sabotage the terraforming effort, or else.' "

"Or else what?"

"The second note was accompanied by a Tupperware bowl of chopped celery. Delivered by Federal Express, no less."

As you may have gathered, my species bears some resemblance to an Earth vegetable form called celery, consumed as food. Add two pairs of tentacles to the midsection of the outer stalks, waste pods on the upper reaches of the inner stalks, stubby legs at the roots, replace the leafy tops with eye stalks, and superficially the resemblance is reasonably close, save that my species is quite definitely "animal" in essence, rather than vegetable. Some intelligences might take offense at the comparison. The coincidences played by biology are amusing. Sometimes I have been even more amused at the idea of eating a life form that looked like a human.

"They got to figure," continued Brewster, "that if a Confraternity member is iced, the assimilation effort will be pretty much knocked off track."

It was interesting. Raw, primitive, and interesting. Fascinating, even. A murder, or even an unsuccessful conspiracy to commit murder, would serve as the basis of a glowing *ktharng* that would get me off this human-infested planet for some place with, say, more advanced creature comforts. Possibilities were there.

"And what role do I play in your scheme?"

"Well," said Brewster, "one role is to assess the SFWA organization and deduce the lines of attack that a Celery might be vulnerable to, given the resources of the organization. This was Sandhurst's idea, by the way."

I considered briefly as we wended our way through a maze of streets and into an underground parking garage. "That seems rather flimsy. There are several thousand Celeries, as you call us, on Earth, with several hundred resident here in Los Angeles. Any number of unsophisticated brute force methods that your species commonly use would suffice."

"Well," said Brewster as the car pulled to a stop, "you can play one other minor role as well."

"What's that?"

"Bait."

After Brewster explained, I had to admit he had a credible point. If a conspiracy could be attracted towards a known, covertly guarded target, it would be that much easier to detect and break up. What he didn't say, but I de-

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duced, was that if somehow the conspiracy *did* succeed, Earth's diplomatic relations would be less likely to rupture and easier to repair if the victim was an intelligence not in an official capacity. Say if the victim were a *kthsprli* currently in dubious standing. Clever. It was an honor I would rather avoid. However, to get back in my editor's graces and obtain a more luxurious assignment . . .

"Mr. Sandhurst is in New York at the moment," said Brewster as we rode upward in the elevator, "but he has sent what information he has compiled on SFWA, along with copies of the threats, to his office here."

As we stepped out of the elevator and into a reception area, we were met by a young human female who was, to judge by Brewster's body language and reallocation of hot spots on his skin, very attractive by human standards.

"Bantam Brewster, private eye, at your service, ma'am," he said, bowing slightly.

"Hello, Mr. Brewster," she said briskly. "I'm Romana Clef, Mr. Sandhurst's administrative assistant." She drew back slightly as she looked at me. "Forgive me, Mr. Brewster, I had expected that you would . . . come alone."

"I'm sorry, Ms. Clef, but I've picked up an associate who will be invaluable on this case. This is Ace Berkley, a Celery journalist."

"*Kthsprli*, Ms. Clef," I corrected.

Her facial features were momentarily as rigid as a human's can be at the sound of my voice. Then she forced a smile. "Whatever. May the intelligence be welcome here," she said, shaking her own hands together in the manner that many intelligences so equipped do when wishing to show politeness without breaking contact taboos.

An intelligence may argue the merits and disadvantages of having one's sensory apparatus concentrated in a head with a face, as with humans. But the human facial structure serves to transmit emotional contexts beyond the intent and control of the mind behind it. And while Ms. Clef offered a passable rendering of a standard Confraternity greeting, it was clear to me through subtle cues of posture and vocal tone that she bore me hostility. Unaware of what offense I had committed, I made a mental note to try to be friendly and helpful if I could.

When we reached her office she sat down and spoke to her computer, calling up several files. "Voice-dependent recognition system for input. How quaint," whispered Brewster.

Ms. Clef turned around and said, "The preliminary accounts were text-only notes sent via electronic mail by Mr. Sandhurst. The fax documents include an extension of the notes and include images of the actual threat notes. Do you want the e-mail, the fax, or both?"

"Just the fax, ma'am," said Brewster.

Ms. Clef stared for a long moment, flicked her eyelids, and turned back to the screen. Five minutes later copies of the documents had been assembled and delivered to Brewster's hands and we'd been escorted back to the elevator. "Will there be anything else, Mr. Brewster?"

"Nah. I'll look them over tonight;

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tomorrow we'll go and check out the local SFWA organization and see if we can start piecing the puzzle pieces together."

"Very well. If you don't mind then, Mr. Brewster, it's late and I have to leave. Good evening."

Brewster edged toward the door and then stopped. "Say, I was wondering if—"

"I shouldn't wonder anything if I were you, Mr. Brewster."

As I had earlier in the cocktail lounge, I caught a brief mental image. Eager to smooth things out, I volunteered an explanation. "Mr. Brewster wishes to engage in mating activities with you, Ms. Clef. Specifically, I believe he wishes to insert—"

Inexplicably, Brewster shot me an alarmed look as both he and Ms. Clef interrupted me at the same time. "I'm well aware of what Mr. Brewster wants," she said, coolly. "Good night, Mr. Brewster."

As we went into the elevator, Brewster turned to face Ms.Clef and raised a hand. "Pax, Romana."

"Four thousand, three hundred, and seventy-eight," she said with disgusted resignation in her voice. The elevator door closed.

As we drove up from the underground garage into an evening of bright neon lights and hurtling automobiles, the notes of a saxophone played far off, mournfully echoing from the walls of the towering buildings.

"Ace, there's things I gotta explain to you," said Brewster.

Early the next afternoon we sat in The Burgers of Calais, an eating establishment featuring a popular native food, before getting on our way to the SFWA offices. I'd spent the night at Brewster's apartment in Pasadena, eating and then going through my dormant metabolic cycle while Brewster slept. My waste pods were now beginning to bulge. Watching Brewster consume his late breakfast with appreciation, without embarrassment of breaking taboo in public, made me envious.

"Go ahead, have a burger," said Brewster.

"I just can't. . . ."

"Come on, Ace, you'll like it. A juicy rare hamburger, smothered in blue cheese and onions. There's no one looking. At least no one that counts, no Celery to *observe* you eating."

"Bantam Brewster, if you and a partner were unobserved by other humans on my home planet, would you engage in sexual activity among a bunch of Celery?"

Brewster opened his mouth and then shut it. He proceeded to eat, slowly, thinking for several minutes, silent for the longest period I had yet observed. Finally, he said, "I see your point. But, yeah, I think I'd at least *try* it. At least . . . depending on the partner," he added hastily.

I twisted my eye stalks to observe the entire restaurant. It was true, there were no Celeries, no non-humans of any sort here to observe. But then, what self-respecting Celery would go into an eating establishment in the first place?

"Of course, there are metabolic consequences—"

"Metabolic, shmetabolic. Have a burger."

Of course, many taboos are a reflec-

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tion of some evolutionary pressures and have no basis in an intelligent, civilized society. Some intelligences may object that this is only a rationalization, that evolutionary pressures or no, taboos serve a purpose, but—I had the burger. And it was delicious. With blue cheese and onions, just as Brewster had suggested. Which just proves that exposures to other cultures, even the dominant human one, can be broadening. I dug into my carrying pouch and extracted a recorder so that I could capture my own reaction to the event. Who knows, the experience might be provocatively entertaining to avant garde elements on my home planet.

As Brewster paid the bill, I said, "There are still some things I don't understand."

Brewster sighed. "Like what?"

"For instance, you introduced yourself to Ms. Clef as a private eye. I was unaware of any taboos concerning vision or seeing."

Brewster snorted as we got into his car. "No, no, no. It's private 'I,' the 'I' for investigator, the private as opposed to public, as in an official government detective." He pulled out a business card and handed it to me:

Bantam Brewster
Private Eye

"The 'private eye' bit is a small joke with language, a double entendre, a pun. And speaking of taboos, what about that crack to Ms. Clef about mating? You know that mating is an off-limits subject for us, as eating is for you."

"But you weren't going to *mate* in public," I protested. "I was merely talking about—"

"Yeah, yeah. Well, from here on out, Ace, don't even talk about it. Mentioning it to people you don't know very well is usually off-limits among civilized Earthfolk, unless you do it with innuendo."

"What's innuendo?"

"An Italian suppository. Now, listen. Since you pulled that stunt yesterday in the bar and then again with Ms. Clef, what gives with this mind-reading trick? Ain't never heard of Celeries being mind readers. *That* hasn't made it into the press. I know, 'cause I read up on just about everything about Celeries before I came calling on you. And if you can read minds, I got myself a walking, talking lie detector and this conspiracy is in the bag. So please don't tell me that you can't."

I paused to consider. "It's not that I can't—"

"Good!"

"—but it's not exactly reading, either. It's an odd function that we discovered shortly after making contact with humans when you encountered the *qqrt'qonq*. Sometimes, erratically, when humans are under emotional stress we get the *image*, not the thought. For instance, when you were thinking of Ms. Clef, I got the image of what you imagined about lying down with Ms. Clef and—"

"Yeah, yeah," he interrupted. "I get the picture."

A most far-reaching taboo, I thought. "The picture, as you put it, is exactly what a Celery gets when it 'reads' your mind. I don't know how you *feel* about the picture or what you *think* about the picture, except from what I can deduce by guesswork."

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"Some lie detector." A horn blared and Brewster used a one-fingered gesture to invite the driver of a speeding pick-up truck to merge in front of him from the Avenue 43 on ramp.

"Even worse. The phenomenon is completely erratic as to when it operates and it's completely inaccurate. I read the image that is in your mind, what you imagine. In the case of your, uh, activity with Ms. Clef, the image had no basis in reality."

"Damn."

"*Damn* that the images have no basis in reality, or *damn* that the proposed activity with Ms. Clef was only in your imagination?" We were passing through the freeway tunnel leading back to downtown Los Angeles.

"Both."

"One more question."

"Shoot."

"Why do we have to do all this driving and passing of L.A. landmarks?"

"It's traditional for private eyes when they're working on a case."

The SFWA offices were located in Hollywood, a part of Los Angeles dedicated to a variety of cultural fringe groups. [Earth maintains an amazing variety of cultures and sub-cultures. No other species has ever been found to exhibit quite the same tremendous variety. Theories vary as to whether the range of culture is a function of rugged and extreme geography or a genetic predisposition toward perversity.]

A Miss Cafe Olay greeted us at a reception desk. For a receptionist of an organization allegedly hostile to the Confraternity's efforts, Miss Olay was exceptionally friendly. Brewster introduced ourselves, and Miss Olay smiled. "Hi ya, Ace. What a surprise to have an aylee as a guest. Welcome to SFWA. And *you,* Mr. Brewster—or may I call you Bantam—*you* wait right here," she said while running a finger down Brewster's tie, "while I go fetch Mr. Gregorian, our liaison officer."

As Miss Olay departed walking with an exaggerated motion to her hips, Brewster whistled softly and muttered, "Boy, I wouldn't mind a liaison with her."

Our previous discussion came to mind and I asked, "That was an innuendo, right?"

"Check."

Miss Olay returned several minutes later, leading Mr. Gregorian by the arm. "Ace Berkley and Bantam Brewster, Mr. Gregorian," she said. And then she walked away with the same oscillating walk she'd employed before. Both Brewster and Mr. Gregorian stared after her.

"Just what *does* she do around here?" asked Brewster.

Mr. Gregorian turned, smiled, and tightened his tie. "Nothing, I'm afraid. But she does it *awfully* well."

Our inspection of SFWA was, for the most part, a disappointment. "Threats?" said Mr. Gregorian as we toured the SFWA offices. "Not impossible, of course. Nothing is impossible. But highly unlikely. Have you ever attended a SFWA meeting? Or read a SFWA publication?"

Brewster shook his head.

"Well. Well, well. Where to start? Our members *are* generally skeptical about the effects of aylee technology. For instance, we feel genetic work to

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extend life expectancies will result in even greater population pressures on resources and social systems that need to be evolved first."

I waved my tentacles. "But we're working with governments on all levels to minimize the problems as we go along."

"Many of us are more than a little suspicious of government. SFWA members tend to be idealists and individualists. A large proportion seem to feel that they have a monopoly, or at least a certified franchise, on revealed truth. Which is why they got bogged down in debating nebulous proposals ad nauseam. Or using the *Forum*—that's our internal publication for members only—to attack each other's personality or intellect. Of course, we occasionally do get things accomplished, such as successfully lobbying Congress on tax matters, solving local grievances, and such."

Brewster looked disappointed. "Still, given the organization's thrust against Confraternity efforts—"

"I'm afraid not. Or rather, I'm happy that it's not the case," said Gregorian, leading us to the door. The timing was good, for I felt one of my waste pods thickening. The hamburger that I had with Brewster was beginning to have its effect, and I would need to be away from human contact shortly.

"I'm afraid that our members couldn't be organized enough to mount a serious conspiracy against a litterbug, let alone a Confraternity target. If there is a genuine threat, it most likely would come from a lone wolf, not a conspiracy," said Gregorian, as once again we stood in the reception area.

Outside, in the smoggy Los Angeles sunshine, Brewster was at something of a loss. "There was absolutely no hint of anything not kosher," he said. "Your presence, if anything, was an object of curiosity, not hostility."

"Agreement, Brewster. But please to make haste. The metabolic considerations that I spoke of . . . I need to get to a private place rather quickly."

We started walking down the street toward where Brewster had parked his car. "But to continue," I said, "I sensed no emotional undercurrents of hostility. In fact, the only hostility I've ever felt from any human was from Ms. Clef—"

"Oh, wow, a Celery," said an excited voice. A man of about thirty human years of age ran across the street to stand in front of us.

"Oh, wow," he repeated. He outstretched his hand, hesitated, and then stretched to grasp my tentacle, which I allowed reluctantly.

"Bipper Jones. Boy, I'm one of you aylees' biggest fans. You just can't believe."

"Yeah, swell, Mr. Jones," said Brewster, trying to lead me away, "but we have an urgent appointment—" What appointment Brewster was speaking of, I was unaware. But I had my own urgency due to a rapidly swelling waste pod.

"And, oh, Celeries are my favorites," said Mr. Jones, stepping back once more into our path. "I think you guys are so neat. I mean, when I was a kid, I used to wonder whether the *Enterprise* could beat the *Death Star*, and then when we found the *qqrt'qonq* in orbit, and the Confraternity—"

"Mr. Jones," I said, trying to move

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down the street to the safety of Brewster's car, "I would dearly love to engage in conversation with you at another time. I'm sure, however, that there are activities you could pursue at this moment—"

"No one expects a fannish imposition," interrupted Brewster.

"Oh, no, I've got lots of time right now," said Jones, happily stepping in front of me once more as Brewster edged toward the car. It was most peculiar, but in response to my suggestion of other activities, I received the mental picture of Jones fondling Ms. Clef. Astonishing, but I had a more immediate problem to deal with.

"It's really quite urgent. . . ." I said. Too late. The waste pod from my left-side stalk ceased to engorge and with a loud eructation of gas, expelled itself from my body. And that, as Brewster remarked later, was when the shit hit the fan.

"Aaaaack," cried the fan.

"Shit," said Brewster.

"Oh, no," I muttered as my body slid uncontrollably toward its dormant cycle.

"Ka-WHAMMMM!" went Brewster's car as it blew up.

I woke up in the Confraternity medical center in Los Angeles. The Tyrdoxil doctor rippled his fins in satisfaction as my eye stalks fluttered into an active position. He gestured to one side and Bantam Brewster hovered into view.

"Glad to see you, Ace. Sorry about this. A fragment of my fender caught you across your central stalk. You're damned lucky. SFWA nearly did kill you and it woulda been my fault."

I curled my eye stalks around each other and fluttered my tentacles in a weak gesture of negation.

"No. Not your fault. Not SFWA."

"C'mon, Ace. No need to be gallant."

"No, listen." I could tell that I was about to lose consciousness again. "Clef is the key."

"Well, Ace. You were right. It was Clef. Clef and Sandhurst and Jones."

It was two weeks after I'd been discharged from the hospital. We were walking down Westwood Boulevard, Brewster eating peanuts from a bag. He was going to get a new car, he said, just as soon as a few clients paid their bills.

I waved my eye stalks in assent. "When I picked up the mental image of Jones, um, engaged in sexual activity with Ms. Clef, I was astounded. Whether it was real or imaginary was immaterial. It proved a connection to Clef. And, given the circumstances, it couldn't be a coincidence."

"Yeah," said Ace, throwing a peanut into his mouth and the shell on the sidewalk, "it turns out he was her boyfriend. He was there to make sure we *didn't* get blown up in the car."

"So I deduced. Besides ourselves, only Ms. Clef knew that we were going by the SFWA offices the next day. And the SFWA people were surprised to see us, you could tell. But I don't understand *why* they wanted to kill me. Or *not* kill me, as the case may be."

Brewster cracked a peanut shell, threw the peanut into the air, and caught it in his mouth. "That proved to be duck soup. Clef copped a plea bargain, fingering Sandhurst as the big enchilada."

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The food-related idioms not withstanding, I still did not understand.

"It's simple enough," said Brewster. "Sandhurst sets me up, gets you—or any Celery—almost killed. I was right, you know. You did provide a convenient specific target."

"An honor that next time I *will* turn down."

Brewster looked at me curiously, but continued. "Next time, eh? Hmmph. Anyway, SFWA gets framed for the attempt, though there's no evidence solid enough to get anyone convicted. And Sandhurst looks the big hero to the aylee community. Or at least that's what he was counting on.

"You see, he's in his early fifties and wanted interstellar gratitude, fast. What's a longer life worth to someone? With an inside track within both the U.N. and Confraternity commissions, what better place to get at the head of line, fast. He just wanted to grow to ripe old age in comfort."

In comfort. The proposition seemed unlikely on Earth, with its noisy, smelly, crowded environment, odd biology, and offensive inhabitants.

"So," said Brewster at last, "with a first-hand, er, first-tentacle account of a phony assassination attempt, I guess you filed a knock-em-dead *ktharnq* for the great amusement of Confraternity members across the galaxy and you'll be on to a more palatable assignment."

In comfort. "Not exactly," I said. "They liked the assignment so much that they offered me the spot of bureau chief. Here. On Earth."

Brewster looked at me for a moment, and then burst out laughing. The sound flew skyward like escaping flutter creatures. "Stuck. Stuck by a job too well done."

"Not really. I told them . . . I told them I was quitting as a *kthsprli*."

"What?"

In comfort. Oh, well. An intelligence can adapt to almost anything. I sighed and reached into my carrying pouch to pull out a business card.

Ace Berkley
Private Tentacle

"I've decided that I like it here. Do you know anyone who might need a partner with insights into non-human dynamics? There's going to be a lot of aylee influence here on Earth for the next couple of centuries, lots of room for conflict."

Brewster examined the card for a long moment, then stuck it in his shirt pocket. "I think that I know someone who might be able to use your services," he said. "Let's go and talk it over. I know a place that has some great burgers." ■

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LAST DITCH

James P. Hogan

In trying to anticipate an opponent's actions, you must consider all the possibilities. . . .

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It was Leonid Yevgenevich Konstantinov's ten-year-old son, Alexsandr, who first thought of the idea that would save the Soviet empire just when its final collapse seemed inevitable, and give it the weapon that would win the world.

Not that Alexsandr had anything quite so weighty and dramatic in mind at the time. He was simply exasperated at being checkmated by his father for the fifth time in a row as they sat playing chess on one of those interminable rainy Sunday afternoons.

"You need to think more about your pawn structure," Leonid said.

Alexsandr reacted with the uncanny ingenuity that boys his age everywhere display in the art of eliminating a problem without actually having to work at it.

"I'd rather use a time machine," he replied after considering the suggestion for a few moments.

His father frowned, not comprehending. "How?"

Alexsandr explained, "If I had a time machine, I'd get a copy of the best chess-playing program that there is and start it running on the biggest computer, and send the computer back a million years. Then, by today, it would have figured out every reply to every position, and I'd only have to look up the right move to win every time no matter what you did."

Leonid smiled dubiously. He wasn't sure, offhand, what a realistic estimate might be for all the possible moves that would make up all the possible games contained in the complete game tree of chess. But he didn't think that a million years would come close, even for the most powerful of contemporary machines.

"How long would it have to run for, then?" Alexsandr asked.

Leonid shrugged. "A billion years, maybe," he replied. He really had no idea, but it sounded better.

A billion years is 365 billion days, not counting the effects of leap years and rainy weekends spent with actively disposed children. Therefore the work that a computer would normally take a billion years to get through would need only a day if the computer were able to run 365 billion times faster. And that, it occurred to Leonid when he was back at work the following day, was only a third of the time-acceleration that could be achieved with the highly secret laboratory prototype of RIACS.

Konstantinov was chief instrumentation engineer at the Institute of Advanced Physics on the outskirts of Novosibirsk, the Soviet Union's "science city" in the center of Siberia. "RIACS," standing for Resonantly Induced Artificial Curvature of Spacetime, had been developed in the course of ultra-classified research into gravity synthesization that the military had been conducting to find ways of confusing inertial guidance and navigation systems.

Essentially, the scientists had discovered that when protons were constrained to circulate at high speed inside a very small radius, at the same time interacting resonately with externally applied electromagnetic fields, a zone of artificially deformed spacetime could be created which mimicked the gravitational effects of a large, highly concentrated mass—but in a way that could be

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turned on and off or otherwise manipulated at will. Theoretically, the mass-densities that could be simulated in this way were astounding—close to the numbers normally thought of in connection with black holes—but practical experimentation on anything but a trivial scale was, to begin with, ruled out by the catch that operating at anything more than a tiny fraction of maximum capability would have the unfortunate effect of pulping every researcher in the vicinity and collapsing buildings for miles around. Then it was discovered that the addition of an outer, counter-rotating system of antiprotons produced a shielding effect that left the inner intensity unaffected but neutralized the external field, and the program suddenly took off. Soon the scientists were able to create and study firsthand conditions which up until then they had only been able to simulate in computer models or speculate as existing in remote and inaccessible regions of the cosmos.

Even more extraordinary, when the roles of the proton and antiproton recirculators were reversed, the inner zone took on the characteristics of "negative mass," which caused spacetime to curve the other way from that induced by ordinary mass. The result was to produce effects that were the opposite of those encountered in the gravity wells surrounding dense objects like neutron stars, where time slows down. Inside the reverse-coupled RIACS, in other words, time speeded up. And the amount by which it could be made to do so was enormous indeed. This was what caused Leonid Konstantinov to reflect that, in principle, the RIACS could perform the same function as the time machine that his son, Alexsandr, had mused about.

"It's a pity that the pinhole is just that," he said to Dr. Yushenko, the head of Project Uzbek, as the gravitational physics program was officially designated, while they were discussing progress over lunch. "Pinhole" was the name given to the zone of highly deformed spacetime created within the inner recirculator: a deep and sudden change of geometry, but highly localized. "If it were possible to make it big enough to take a computer, we could have the ultimate chess analyzer."

Yushenko stopped, fork poised just as he had been about to take a bite of *beefshstek*, and stared at Konstantinov, intrigued.

"That's an interesting notion," he said. "I hadn't thought of anything like that. Quite ingenious. What made you think of it?"

"Oh, something that my son said yesterday. He wanted to send a computer back in a time machine so that he could beat me at chess. RIACS could do the same thing."

"How old is your son?"

"Ten . . . just."

"He must be a bright boy," Dr. Yushenko commented.

Which was the point that Konstantinov had been trying to make.

Yushenko found the notion amusing and mentioned it that afternoon to the director of the institute, Mikhail Drodzhkin, during a break in a meeting of the appointments committee. And Drodzhkin, although he didn't say so, *did* know, not of a RIACS big enough to take a computer, but of a computer small enough to run in the RIACS they

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already had.

Another of the Institute's secret programs was concerned with duplicating the production of molecular-scale processors and diffusion-array bulk memories from unpublicized Japanese research designs purloined through espionage. Hence Drodzhkin was one of the few people anywhere in the world who was aware that both technologies existed. The implications of combining them together were so startling that he booked a flight to Moscow the next day to bring the subject to the attention of Vasili Zladik, the minister of science. To illustrate the potential of what he had in mind, Drodzhkin used the same example of an unbeatable chess player that Yuskenko had talked about.

"With a processor capable of examining positions at that speed, and a memory the size that we can make now, you've got a system that will analyze the complete game tree," he told Zladik across Zladik's office in the Central Committee Building. "From any position, it would be able to compute every path to every possible ending. Therefore it would always be able to steer the game along a path that leads to a win for itself. It would be invincible."

"A fascinating conjecture, Comrade Drodzhkin," Zladik agreed woodenly, completely missing the point. Games? The director had flown all the way from Novosibirsk at departmental expense to talk about games? Zladik was a political creature who had been made minister because of his reliability and party loyalty, not for outstanding brilliance in any field of science.

Drodzhkin accepted such a situation as normal and took nothing amiss. He added, smiling whimsically at what was intended to convey that he understood the depth and weight of the Great Man's problems, "It's a pity that we didn't have it sooner. It would have been the one thing that the West could never have matched. An invincible weapon!" Zladik jerked his head up and was staring at him fixedly, but Drodzhkin failed to notice and carried on in what was supposed to be a mildly joking manner, "All this preoccupation with tanks and megatonnage has been a waste of time—and in the end it got us nowhere, anyway. Shooting wars on any large scale belong to the past. Being *cleverer* is what we should have concentrated on, not on being stronger."

Zladik thought for a few moments more, and then mustered his sternest expression of bureaucratic disapproval. "Such an attitude is completely contrary to the policy of the party, Comrade Drodzhkin," he rebuked stiffly. "Our official posture toward the Western democracies is one of detente, mutual understanding, and peaceful coexistence; not a continuation of the futile adversarial relationship that you seem to be advocating. I must consider this a severe lapse on your part."

Drodzhkin's reassignment as technical supervisor at an unheard of meteorological station on the Taimyr peninsula in northernmost Siberia was arranged in less than a week. Zladik then made an appointment to see Yuri Grymokolov, the Soviet foreign minister, on what he claimed was a most important and highly confidential matter.

"It is a project that we conceived some years ago," Zladik said from the far side of the vast desk in Grymoko-

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lov's office at the foreign office on Smolensky Square. "But because of the technical uncertainties and the consequences that would have followed from false hopes being raised prematurely, I judged it best to keep a security blanket over it until we were quite sure."

Zladik spread his hands briefly. "Every possible game traces a path through a branching tree that must end in either a win for white, a win for black, or a draw. At the beginning of the game, white has a choice of twenty possible first moves: sixteen with pawns and four with knights. Similarly, black has twenty possible replies. Suppose that white opens by picking the first of the twenty moves available, and that black answers with the first of his twenty possible replies . . . and so on for all the billions of games that could follow from white's first possible move. Now go back to the beginning and suppose that white plays, instead, his second possible move, and then go through the whole—"

"Thank you, but I am familiar with the rudiments of the game," Grymokolov interrupted. "I *did* have the benefit of a modicum of schooling."

Zladik subsided and nodded obsequiously. "Of course, Comrade Minister."

Nevertheless, Grymokolov had evidently taken the point. "You're saying that every outcome would be an open book to such a device," he said.

"Quite."

"It would be infallible? You could steer the game along a winning branch every time?"

"Yes. Exactly. In the past, the snag has always been that the number of variations becomes so large that no computer ever built could get through even a fraction of them in the estimated lifetime of the Solar System. But now we have one that can."

The foreign minister stared down at the mahogany expanse in silence for a while, then looked up.

"Who else knows about this?"

"About the entire scheme? Nobody. I was meticulous in keeping the various component activities strictly compartmentalized."

Three days later Zladik was committed to a psychiatric institution, certified as suffering from schizophrenic delusions and acute psychological instability. The following morning, foreign minister Grymokolov gave a closed-door presentation to a specially convened meeting of the secretary general and the inner council of the Politburo.

The outcome was a sudden and totally unexpected public offer by the secretary general of the USSR to the United States president and other heads of the western world: the Soviet Union would renounce its claims and scrap all of its weapons, nuclear, conventional, strategic and the rest, if the West would agree to do likewise—and let a single game of chess decide who would take the world. They announced simply that they had an unbeatable machine: *Kosmik Marx 1*, they called it. The West could put up people, computers, a mixture of both, against it. It wouldn't matter.

What could the West do? The tone of the challenge made it clear that whatever pundits and experts might be saying in their haste to write the Soviet empire off as a lost cause, it was still

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capable of causing plenty of mischief yet before it went under. The rest of the world, flatly refusing to resurrect all the fears that it was finally able to put aside after almost half a century, left no doubt that it would rather be checkmated than cremated, and the president found himself with no real option but to accept.

The US assembled a consortium of the best chess brains and programs that the West could muster. They drew first move and spent weeks debating before they announced their opening: P–K4.

In Moscow, chuckling technicians fed the move into the machine. The world waited breathlessly, while inside a tiny realm of almost infinitely accelerated time, whirling streams of binary digits computed and compared all possible continuations to their endpoints, arriving finally at the inference of flawless logic.

At last the printer clattered. The UN observers gathered round to announce the perfect opening reply to commence what would surely be the most momentous game ever played in history.

But there was one small thing which the analysts assembled by Grymokolov's department had overlooked in their haste: A fundamental principle of sound chess assumes that one's opponent will always play the best move available . . . and do so all the way through to the end.

Kosmik Marx 1 had resigned. ■

●We enact many laws that manufacture criminals, and then a few that punish them.

Allen Tucker

Kelvin Throop's Dictionary of Politically Correct Usage

● **macho** (adj.): Of or pertaining to male behavior. It is always followed by the noun "bullshit." In approved usuage, it is applied to any and all male behavior of which the speaker disapproves. Thus, a man holding a door for a woman and a man forcing a woman to walk two paces behind him are both machobullshit. Only complete and total acquiescence to the woman's will is exempt from this label (see "wimp").

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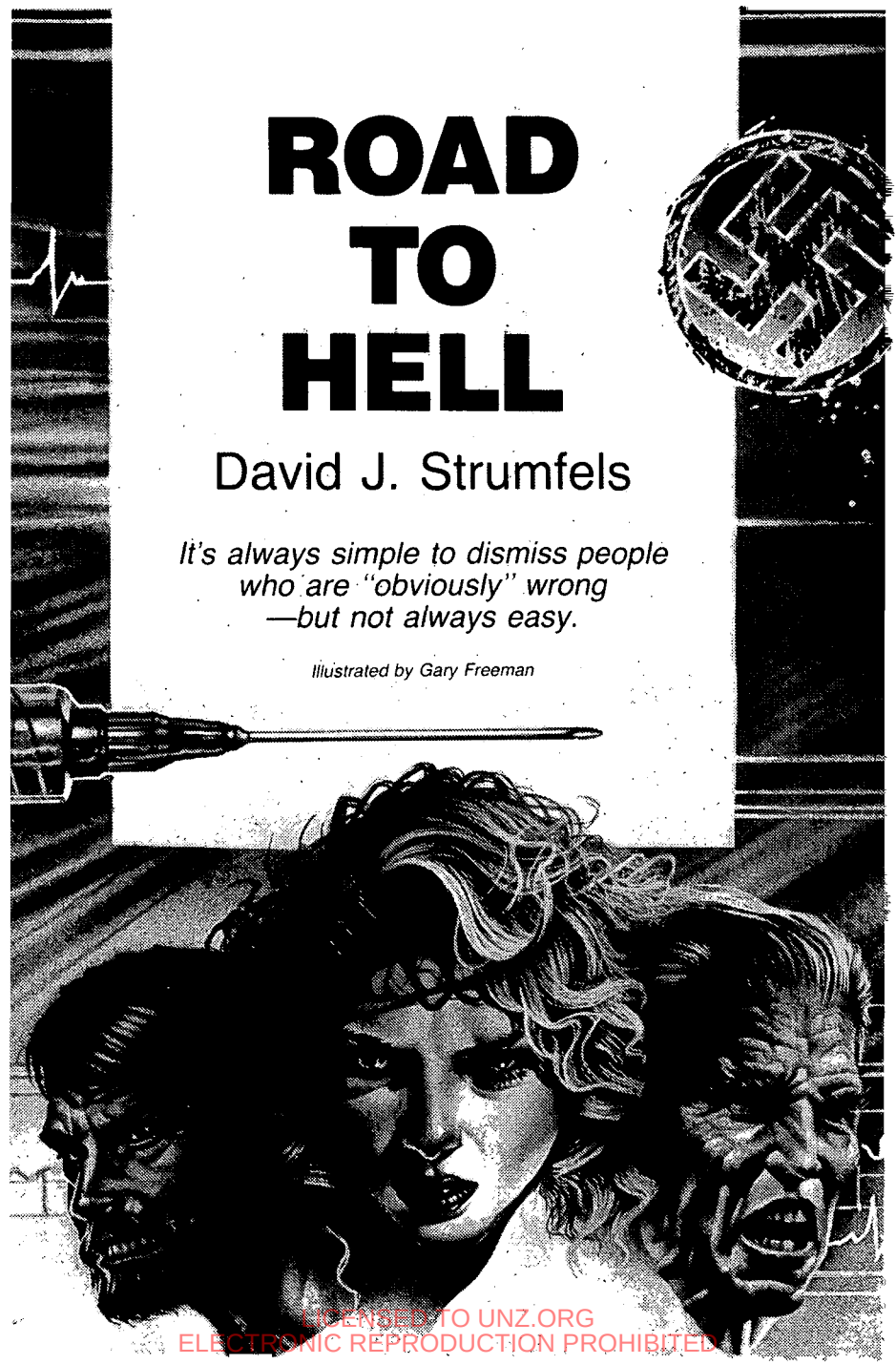
ROAD TO HELL

David J. Strumfels

It's always simple to dismiss people who are "obviously" wrong —but not always easy.

Illustrated by Gary Freeman



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"Jeffrey died on April 24, 1996, at 3:03 A.M.

"That is, 3:03 A.M. was the time given in the official reports. The truth is, nobody knows for sure when Jeffrey died; like all deaths, Jeffrey's wasn't a moment in time, a chronological point you could point your finger at and say, 'There, that's when it happened,' or store on a computer disk for incorporation into a database. It was rather a torturous seepage of the spirit, a waning of inner light, a resignation by narrow degrees until lethargy had imperceptibly replaced the energies once taken for granted; and then the transition, so nebulous that no one can say now there is life and now there isn't, so subtle that we are frightened by our realization of the tenuousness of being. It is only when we are certain of consensus that we say what we cannot define has occurred. But it has happened: the heart is still. The hand that had squeezed ours neither feels nor offers feeling; the eyes that had looked at us so knowingly and trustingly for years see nothing, are marbles on a waxen face which can never smile again. How strange it is, that it is only now that we remember what he had been before becoming ill—the energy, the spirit, the pure joy of living. How strange that we should have forgotten all that until its last remnants are taken from us—like a man who has been slowly losing his sight but cannot grasp the loss until the darkness is total. How strange."

"You can't be serious, reading that garbage."

Libby slammed the magazine shut, spun and faced the ascetically narrow face of Dr. Gottwald, perched atop his bony frame. "P-Paul, what—how long have you been standing there?"

"Long enough to see, not long enough to believe what I'm seeing," Gottwald said, the beginnings of a contempt that was never far away coming through his thick accent. " 'My Friend Jeffrey'? Since when have you been into Animal Rightism?" *I thought you had more sense than that,* he didn't have to add, no doubt the only reason he didn't. "Not that it isn't a very moving piece of prose, but, come on already—a monkey? Who could take nonsense like that seriously?"

Libby smiled weakly, sensing the flush in her face. Gottwald intimidated her under the best of circumstances, and these were more than a little bit compromising.

"Where did you get that anyway?"

"Allison had a stack of old magazines she was throwing out," she offered. "I was going through them, trying to find anything of interest. That's when I came across it. I'm surprised you don't recognize it; it's pretty much what got the Co-Human Life bill passed four years ago." She remembered that that was probably why Gottwald didn't recognize it—he was still in Prague then, fighting his own battles—and flinched with redoubled embarrassment. "That's why I was reading it."

Gottwald fingered his jaw. "Oh. Well, in that case, my deepest apologies—and thank God you haven't gone off the deep end, too."

"Thanks." Gottwald's sarcastic insensitivity had always grated on her, more than she liked to admit to herself. No doubt, it was why she had never been able to bring herself to tell him

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about her brother—she couldn't bear the thought of wasting an entire day emotionally distraught over the callous remarks that she was certain would fall from his mouth.

Besides, she didn't have the luxury of wasting days like that.

For that matter, even the twenty minutes she'd spent reading this irrational tripe was close to criminal. She tossed the magazine aside. "Well, I guess I'd better be getting back to work—talk to you later, Paul."

He nodded, not really noticing her anymore. As she was leaving, she saw him sit down with the magazine and pretend to casually leaf through it. She shook her head.

When Libby got to her office, she found that the simulation had already finished running. The results were casually splayed across her printer in a cascade that ran down the back of her desk onto the floor. One of these days, she told herself, she would have to get around to removing all those lines she'd put in the software for debugging; not only did they make for a great deal of unnecessary paper, it also took her that much longer to decipher the printout—probably more time than the needed source code revisions and recompiling would take, she noted cynically. But she knew she wouldn't do it, not yet. She just didn't trust the program well enough to accept its output without qualifications; those debugging lines were a security blanket more than anything else. *For all the good it does.*

She gathered up the great white stream, sat down, and got to work.

Barely ten minutes later—it must have been divine intuition or something, as she had just finished assimilating the results—the phone purred its impatience. "Hi sis, how're ya doin'?"

"Hmmm, this voice is sure familiar. . . ." There had never been a straightforward greeting between them as long as she could remember. If she didn't give the twist, Jeff did, or sometimes they both went at it for a while—a silly, childhood's game that neither of them wanted to lose at.

"Getting anywhere with those new designs?"

Well, maybe not this time. Actually, not for—she caught herself, stopped herself from thinking about it. "Do you read computers' minds? I'm holding the results in my hands right now."

And? But the line was silent.

Libby suddenly wanted to lie to him—that, too, for the first time in her life—tell him that these new designs had been an abysmal failure. It was savaging her, this constantly finding new reasons/excuses to hope, only to see yet another treatment fail in the clinicals. And it was cruel to him. But what choice did she have, when the alternative was sitting back and doing nothing while he wasted into death? "I—I have to tell you Jeff, it looks like another hit. At least, the first runs came out positive. But I'll have to test it on some more complex models: rats, pigs, rhesus."

"I don't understand why you have to go through all that rigmarole," he said. His voice was not angry, only tired. "I mean, you're not dealing with living organisms, so why keep all that bullshit? Why not just go straight to the human sims?"

She fought off tears. *We went through this last time, and the time be-*

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fore, remember? Was his mind really going too? It was possible: god only knew what opportunistic viruses and bacteria had gotten into his brain, were eating away the fabric of his consciousness one neuron at a time. So, it was to be this too; she hadn't expected to suffer through. . . .

She corrected herself: it was his suffering, not hers. And it was inhumanly selfish of her to think otherwise. Besides—besides, yes, there could be a blessing in this as well, the blessing of a dumb animal which does not fear oblivion because it cannot abstract, cannot understand that it is dying, will be no more. A macabre thought, but one whose logic she felt helpless to escape. *Yes, let his mind go, in inches and degrees so that he isn't aware of it; if I can't bring him back, at least let him go with that much mercy.*

"Sis, you still there?"

She jerked back to the present. "Huh? I'm—OK. What were you saying? Oh. Why we can't just do humans first." Why indeed? There were reasons, she had explained them so many times herself, but suddenly they had abandoned her mind, like ungrateful children. Think Carver, think for Christ's sake! Oh yes, that's right, that's why. "First of all, a new drug still has to be proven safe on all the models; that's company policy, in anticipation of the FDA regs. Second, doing the complex simulations right can take weeks and months, and there's no point investing that much computer time until you know it's going to be worthwhile via reason one."

"You sound like an FDA inspector, spouting that." Jeff sounded bitter.

"Hey. Cut me some slack. I didn't make the rules."

There were several moments of ticking silence before he replied, "That's true. Sorry sis."

"That's all right. Hey, I didn't—" but it was too late; the web of guilt was already swirling down tight around her. Guilt and anger. The twin antipodes that somehow made a continuum.

Her mind spun back to the article. Of course, it was just a coincidence, the author choosing the name Jeffrey. It was an innocent, boyish name, something with which to arouse the audience's sympathies for a dumb animal that had no capacity to understand what was happening to it and felt no pain—that had never loved or hated life, had never gone camping with its big sister up on Mount Palomar and spent the night teaching her the constellations, or jealously hurled rocks into the middle of her tenth birthday party, or—

—she was being irrational. There was no reason to think it would make any difference if that bill hadn't passed. Perhaps the Animal Rights lobby was right in its claim that computer models did as good a job of predicting the effects of medicines as did research with live animals. Certainly, there was no conclusive evidence otherwise. Perhaps. But that was another hook to hold onto, the faith that Jeff would be well again if only a bunch of ignorant moralists hadn't been able to jam their unscientific and antiscientific notions down civilization's throat. Or at least, if not Jeff, then others, no doubt thousands, perhaps more.

She was holding the dead phone, the dial tone a thin keen of mourning in her

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ear. Libby was only half conscious of what had happened: his damning her for apologizing, for not being willing to give it back to him the way she always had, for burying him with pity and guilt that he was sick to death of for dismissing him as though he were something pathetic, for not loving him anymore. And her offering only more apologies, more confessions and pleas of guilt to his recriminations; and his growing angrier at her alleged inability to understand, except that the anger swiftly consumed whatever energy he still had and replaced it with a resigned moroseness that made her wonder if this really were Jeff she was talking to. All this while she was thinking at the same time, as though two voices were simultaneously competing for her attention, like spoiled children. The odd thing was, when one stopped, the other did also, as though they were of one mind. Which they were.

She put the phone down and leaned back in her chair, staring at the ceiling. The speckled patterns were like stars in the night sky.

Jeff was right. Why did she have to go through all this bullshit? After all, she had the computer, the compiler, the skill—it would be almost a trivial task to fake the model results so that no one could ever catch on.

She shook her head, shocked to find herself even considering such a course of action. But what was even more disturbing was the invincible morality to it; it kept resurrecting itself however she tried to put it to rest. Considering how unsuccessful the models had been in predicting clinical results, it would seem that ethics demanded that she find some way around such a criminal waste of time and resources, even if it was such a blatant violation of all professional, corporate and legal ethics that, if caught, she could certainly kiss her career goodbye and even stood a good chance of ending up in jail.

On the other hand, what was all that against the possibility of saving her brother's life? And how many other lives as well?

The ceiling offered no answers.

She had to get some fresh air.

Stop the exploitation of co-human life!

Support our animal friends and loved ones!

Science to save lives, not destroy them!

Those were just a few of the banners, placards, and shouted slogans, the few she was able to make out against the throng of passersby who had surrounded the protesters. Her instinctive response, although she had walked out the front door only a moment ago, was to wonder who could be the target of the protest. It was when she was spotted, and fingers started pointing in her direction, that she started to get a very unpleasant feeling in the pit of her stomach. The resolute approach of figures bearing recording devices and logos of local news organizations abolished all doubt.

Murderer! Killer! Have you no shame?

Several devices were shoved before her face at once. She maintained her aplomb and answered their questions politely, straining to be heard over the din. Yes, I am an employee of . . . in

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the research department, yes . . . Dr. Carver . . . biochemistry . . . yes, I am involved in . . . uh, I'm afraid I can't talk about our sources of data . . . no, I won't deny it; I won't say anything at all about . . . of course we use electronic databases (stupid!) . . . no, it doesn't disturb me at all . . . I'm afraid I don't get the gist of your question . . . you want to know what I think about what? . . . what's this all about anyway, if you don't mind my asking a question for a change?

End the outrage!

Remember Jeffrey!

She quickly read the hand-out one of the reporters had thrust at her. Unable to believe it, she tried a second, lower scan. Then a third. Then she handed it back to the person who'd given it to her, who made no attempt to accept it, whereupon she crumpled it up and dropped it into the nearest waste basket.

"This is insanity."

More questions were jabbed at her, but she fended them off, and headed straight for the center of the protesters, parting through the wall of defenders as though they were a minor nuisance.

The marching circle of banner holders froze into silence when she reached its fulcrum. There were at least a hundred people either participating in or temporarily swept into the protest. A shining angel, descended from heaven, could not have directed all those eyes at a single point as effectively as her entrance had. With a few brief motions, she had brought the hurricane to a halt so that its energies were suspended on the tip of her will, like a spinning top; and now those energies were, for a moment or two, hers to mold as she saw fit, or dissipate into history.

She thought she was going to be sick.

"Who's in charge here?" She looked about at the suspended faces. "Do you have a spokesperson? Well?"

She thought they would stare at her until the men with the straitjackets came, but finally a placard was lowered, and its holder walked up to her with upright hands, his palms facing outward. Medium height and build, closely cropped black hair and beard, brown eyes, full lips, blue sweatshirt with no printing. His palms literally radiated at her.

"It's OK," he was saying, "It's OK. We don't want a fight. We respect your views. We just want ours to be known, that's all. No need to get hostile." The hands were gesturing, almost genuflecting before her.

The man's behavior did have a calming effect. She hadn't realized she was so agitated. Taking a quick breath, "Do you speak for these people?" She gestured at the other protesters.

He nodded. "Sometimes. If you'd like to talk, why don't we—"

"Are you serious?" She was close to shouting again, despite herself. "Are you really proposing banning the use of animal data too? Do you have any idea what that would mean? What are we supposed to base our computer models on? Or are you so hungry for political power that you don't care who suffers?" *Or how many?* She didn't want to think about why she hadn't put it that way.

"I assure you, we care very much about suffering," the man said. He'd cupped his palms together, so that they faced the sky now. Indeed, everything

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about him—his tone of voice, body language, facial expression, the way he made full eye contact as he spoke—made it irrefutably clear that he did, too. "But any reasonable person can see that there must be limits. For example," he licked his lips. "Would you use data from concentration camp experiments? I mean, even if it were legal?" He gave a short, sharp smile. "You see my point: how can it be wrong to use data from amoral experiments on humans, but acceptable to use the same kind of data from experiments on innocent animals? If one is evil, the other has to be evil, too. And should be outlawed the same way. That's all we're asking for. For morality and the law to be consistent."

She had been prepared to say something but the simple elegance of this argument stunned her into complete silence. Of course. Of course. It was not simple insanity after all: no, this was madness driven all the way to its logical conclusion. It was the final, perfected inversion of rationality; the cleanest fraction of absurdity, distilled away from all reason or common sense humanity. It was the mother liquor of perverted morality.

The man smiled even more broadly, with the assurance of one accustomed to finding his positions both morally and intellectually unassailable. Almost simultaneous with his smile, as though it were a cue they had long ago become conditioned to take, the protesters hoisted their burdens in the air and resumed their reverie.

At the same moment, she also realized that several of the reporters had wormed their way through the crowd, and had been taking down every word of the exchange—words that would reach ten million ears and eyes before nightfall, and ten times ten times that many before the light returned. The reporters were already beginning to turn away, the victor in this confrontation obvious.

The top was spinning off her fingertips, into the unbalanced chaos of empty space. She groped, hunting for the mysterious force that would return it to her mastery.

"Yes. Yes, I would use it, if I could. Even if it were—if I thought it could save my brother's life, I wouldn't hesitate. I wouldn't hesitate for even a moment if I thought it would help."

The top hovered, as the minds around her grappled with the possibility that the laws of the universe were not what they had thought. She could see the confusion whirring in their brains.

The man was the first to speak, though he misunderstood. "Of course, we are all our brother's keeper; but a dog is as much my brother as—"

"Your brother, Dr. Carver?" One by one, the reporters turned too, faces eager for a renewal of the battle.

The bearded man's expression narrowed. Calculating. Recalculating.

What are you doing? You have no right . . . besides, this won't save his life; you're only denying him a death with dignity, with privacy. . . . "That's right. My brother, who's dying in a hospital right now, as I'm standing here wasting time with these—people." She told them everything; the initial symptoms, the lethargy, the shrugging haven't-got-energy-to-care impostor that had seized his body; then the diagnosis, and

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the prognosis, and gnosis of having to accept it and learn to live with it, the gradual denial of a vibrant past; then the slow surrender, piece by piece, of a life—job, friends, hobbies, movement, standing, sitting. Finally, she told them about the permanent admission, the stealing of vitality breath by breath, the final death of hope, and the relentless festering sore wastage of flesh which huddled beneath jaundiced, metronome blinking eyes that wanted only to be released from its hell. *I'm sorry, I had no business telling these jackals, but* . . . but she had been forced to fight, and had no other weapons; when your only tool is a hammer, your problems all become nails.

Her antagonist was again full of compassion; for a moment, Libby thought he was even going to embrace her, and she caught herself retreating just in time. "I—understand. Of course. I'm sure if someone I loved was going through something like that, I would have a hard time focusing on the moral aspect of the issue too."

In retrospect, she wasn't certain what had happened to her at that moment. She had no experience in public debate, having even stayed out of the acrimony surrounding the use of human fetal tissue. But that . . . that had been different. It was personal this time. And she sensed her opponent's blunder, the opening he had given her by his clumsiness—or was it by design? Perhaps she was stepping into a trap.

If so, there was no choice. She couldn't stand on the sidelines forever, after all. "Moral aspect? Yes, let's talk about the moral aspect Mr.—"

"Deshea. Greg Deshea. Of the Organization for Ethics in Scien—"

"Let's discuss the moral aspect of the issue, Mr. Deshea," she cut him off. "The fact is, your propaganda about computer models being enough to predict which medicines and treatments will work and which won't is just that: propaganda. And it will remain propaganda as long as we can't do the experiments needed to collect the necessary data. And that, in opposing animal experimentation in medical research, you are by default endorsing human experimentation. In other words, you favor *human* death and suffering over humanely done experiments on animals, animals that can have no concept of what is happening to them. That is what you and your kind stand for Mr. Deshea, and no amount of moralistic posturing or sentimentality about 'our animal brothers and sisters' can change that."

She didn't realize until she'd finished her harangue that the rightist had been giving her his full attention, even to the point of nodding thoughtfully at what she considered her strongest points. He even waited until he was certain she had finished before formulating his reply. "Those are some very strong sentiments that you have expressed, Dr. Carver. Again, I can understand your *personal* feelings about the issue." He emphasized the word *personal* in a manner simultaneously innocuous and potent. "I can, however, refute each one of them. For example, I could challenge you to explain why, if you believe that animal suffering is always preferable to human, you are willing to accept any ethical guidelines at all in animal experimentation. In the name of accurate sci-

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entific data, shouldn't an animal be made to suffer exactly as much as a human being, and in the same way?"

He did not give her the opportunity to answer. "I could ask a lot of questions like that, but I won't. I won't, because I don't want to evade your main challenge. You may indeed be right about the propaganda; at least, I'm willing to accept your claim about not having enough data for your computer models. I don't know, not being an expert." He paused to let this revelation take hold; to challenge her to explain why it mattered—this was a moral issue, after all. "So your question is: where should the needed data come from? Human beings or animals? To you, the answer is animals; because, as you say, they can't understand what is happening to them anyway—by which you really mean that we have the power to do it to them, while they lack the power to stop us. Whereas we say that no ethical creature demands that another suffer for its own personal gain, even if that gain is relief from suffering. No ethical individual would do such a thing, and neither would an ethical species. So the answer to your question is, yes: we prefer human suffering—even our own suffering, or that of someone I love—over animal, if the beneficiaries of this suffering are human. We fail to see how ethics can permit anything else."

For the first time, Libby noticed that among the surrounding faces, there were some directed with loathing toward that which commanded reverence a few moments before. She had to admit, if only to herself, that she respected his courage and candor in answering her question, even if he did it in a way designed to deflect its emotional impact. It made her look at him in a way she wouldn't have expected. *Just possibly, this is a mind I could deal with.* But it certainly hadn't gained him any followers; several of his group were looking at him with consternation and disbelief.

One of the reporters asked, "What's your brother's name, Dr. Carver? For the record."

Her antagonist's eyebrows turned upward.

This time it was her turn to smile. "Jeff."

"Excuse me, I didn't catch that."

"I said—Jeffrey."

The worst thing was, the incident had shaken her enough that there was no point in trying to get more work done. She blew off the rest of the day walking about, shopping, sightseeing—anything that would calm her nerves and let her recollect her mental energies. Not for the first time, she wondered how anyone could actually make a career—if that was the right word for it—out of that kind of confrontation. Incredibly, some people seemed to thrive on it though. They must have naturally high endorphin levels or something that kept them tranquilized, she concluded.

As always, any blown day had to include a hunt through one of the big chain book stores, on the theory that, given enough quantity of printed matter in one place, some diamonds might be found amidst the coal.

She was disappointed in this too, however. Even the Science & Nature section offered nothing new or notable, just the usual revolving-door selections

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of Back to Nature and Save the Planet and similar fodder, titles, authors, and covers she was certain were only periodically shuffled to give the impression that the substance was fresh; while most of the science in them, however sincere, was either worthless or presented in misleading ways which avoided the complexity of the issues involved.

Depressed by now to the point of despondency, she went home, took a hot bath, and went to bed without bothering with the dinner she'd planned. She was supposed to give Jeff a visit this evening—well, she could always make the excuse that she had been working late when he brought the subject up tomorrow morning.

That didn't help her sleep either.

Indeed, she gave up trying around five in the morning, and decided that an early start was the best way to make up for lost time. She even looked forward to the two hours or more she would have before the hectic bustle of the normal work day began; just the thing to clear her mind and set the creative circuits into action—given, of course, sufficient lubrication in the form of black coffee.

In retrospect, she realized that she should have known better. At the time however, finding a fresh message on her answering machine was the last thing she was expecting. She was so amazed (and irritated at a cosmos that never, but never, gave you any quarter) that she had to play it three times before the words were retained by her conscious mind.

Then she had to play it twice more before she could believe it.

Sure enough, a Mr. Sherman MacReady answered the number she entered. His voice had a faint accent, one she couldn't make out though. "Ah, Dr. Carver," he intoned when she identified herself. "I was hoping to catch you bright and early!" He sounded frighteningly awake.

Where was she calling anyway—Outer Mongolia? "Yes, well, I got in a little early today." *And you sound like it.* "Um—I heard your proposition."

"You have to admit, it's a real chance to—"

"Is this on the level? I mean, this is for real, isn't it?"

MacReady didn't answer right away, and when he did, his voice sounded appropriately hurt. "I assure you, we wouldn't dream of taking advantage of you, Dr. Carver. Our proposition is decidedly for real. Naturally, we're willing to cover all your expenses, and there will be compensation for your valuable time, the amount of which to be determined by mutual agreement—at your convenience naturally."

"But—but I'm not a public debater!" she was already protesting. "I'd be eaten alive on television."

"Ahem. If you'll pardon my saying so Dr. Carver, I thought you held your ground very well against those activists yesterday."

Oh Christ.

"Needless to say, it is your decision. Having already volunteered to be a spokesman for the scientific community however, I can't see how you think you will help your cause by stepping down again; if you ask me, the activists will have a field day, if you do that."

Spokesman? Volunteer? "Wait a minute. I was just a—a concerned citi-

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zen, reacting to a demonstration by other concerned citizens. You know, democracy in full flower. I'm not interested in becoming a leader for a cause. I haven't got the time for that." *As well as a few other things I'd need.* But she saw no need to invite arguments.

"I know, I know," MacReady said. "The dedicated scientist, much too busy for such vulgar acts as public speaking; while the activists, because they spend not a whit of their time in productive activity, spend their days gaining the public's eyes and ears—and hence, the public's consensus, and the reverence of politicians. Which no doubt explains in good portion how things got the way they are."

Libby shook her head, as the words blurred through her. She'd dealt with salesmen who couldn't talk this fast, or glibly. But, she had to admit, a lot of what he said was reaching her, resonating with similar thoughts she had herself. MacReady had obviously researched his subject.

"I can't possibly give you a fi—an answer right this moment," she finally said, making sure not to put it as a question, however rhetorical. "Look: can I get back to you, say, oh—"

"I need an answer by the end of today, if we're going to have time to make the arrangements," MacReady cut in. She could feel him rubbing his palms together in triumphant glee. "The show is next week: either you're there then, or the activists go on without opposition."

She was starting to get angry. "Don't give me that. The world isn't going to fall apart if you don't get your CDs made in less than—"

"It's a live show."

She almost slammed the phone down right then and there. "I see. OK. All right. In that case—" what else could she do; he was right, she couldn't let them go on without her, not after having stood up to them yesterday. *Damn it, why didn't you just walk away, why did you have to let it get under your skin, why did you have to let that stupid brother of yours*—"By the end of today. You have my word on it."

"I'm confident you'll do the right thing, Dr. Carver."

She almost screamed when the connection was broken.

Now what?

Yesterday's printout still lay in a crumpled pile on the other side of her desk, a billowing snowball of useless data. A single, furious sweep of arm cleared the detritus, sent it fluttering to the floor like a paper accordion, where it collapsed into a pile of much the same size and shape. Jeff was right, it was BS. Science was BS. Science with manacles and a blindfold, and its hands tied behind its back and its tongue cut out for good measure was BS. Especially when you'd just been anointed and appointed to stand at the ramparts, so that you wouldn't have time for the real thing anyway.

Especially when Jeff was lying there, dying.

OK, you win, I'll do it. And may God have mercy on both of us.

Jeff. What the—he should have called first thing this morning, left his own message on the machine: Where the hell were you last night, sis?

She forgot she was in unusually early; breathed a sigh of relief.

That led to another idea. Perhaps just

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the sort of idea that would preserve sanity—and atone for her sins, absolve her guilt, undo her deeds, and prevent crimes. *Sorry little brother, couldn't make it last night, I was tied up at work, but see—see?—I haven't forgotten you, here I am in the flesh. See, I still love you, I'm still beside you? So don't get cross with me.* Something like that, although when she actually thought it out, it sounded pretty silly and maudlin. But it felt right.

The taxi ride was a ten minute eon. At the last moment she checked her appearance, ran a brush through her thick, curly blond hair, and daubed a bit of makeup on. She always made sure Jeff never saw how run down she was; fearing, though she never actually articulated so to herself, that if he knew the price she was paying for his dying, he would only become that much more determined to end both of their suffering.

She moved from the lobby through the halls and elevators as though in the fog of a dream, admiring as she always did the clean efficiency of the men and women passing her. She wondered if she could be so professional if she were constantly surrounded by what was behind the doors on either side of her. There was something cold and non-human about it actually. Then she realized that the truth was really the other way around: it was the way she dealt with death and disease that was detached and indifferent to the human dimensions—almost as detached as the animal rights extremists, although nothing could equal that level of evading humanity.

"Hey, little bother—er, brother—look who came to—"

The room was empty; disheveled and dirty, brown stains all over the place. Looked like someone or something had gone nuts in there.

Wrong room, stupid. Which meant that Jeff had probably heard her idiotic outburst, and was busting a gut over it right now. Unless it was the wrong floor too, in which case she was an ordinary *schlemiel*.

But the wrong room wouldn't have Jeff's name on the door.

She retreated to the nurses' station. "Excuse me, could you tell me where Jeffrey Carver has been taken?" She interpreted the nurse's expression. "I'm his sister."

"Oh." The man looked around, searching for help, but there was none. "I'm afraid your brother was taken over for emergency surgery late last night. . . ." His lips narrowed to a thin line at that point, and wouldn't permit further words to pass.

"Emergency surgery—for what?" She looked back at the room. The stains made a clear trail from the door down the hallway, she saw now. It was also now quite obvious what the stains were. . . .

. . . Which was the last thing she remembered before the feel of something cold turning warm on her forehead, and the gentle voice, "Ms. Carver, Ms. Carver, are you all right?" entered her consciousness and coaxed her from oblivion. Something cool to drink was pressed against her lips; she decided to decipher its contents later, right now it simply felt too good.

Jeff!

"I'm very sorry Dr. Carver—"

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"We did everything we could. The blood loss was just too great, particularly in his condition."

"We'd like to express our deepest condolences for . . ."

"He left this disk, addressed to you."

I'm not going to listen to this. If I read it, it'll all be true, and it can't be true. This has to be a vicious nightmare I'll wake up from any moment now, wake up from to find Jeff strong and healthy and funny and wild like he's always been, always will be.

Right; and we'll be kids again, and I'll be lying on the side of Mount Palomar, looking into a numbing night sky.

She didn't consider the permanent sleep until she got back to her office.

Sis—

I can't let you do it. Don't deny that you were going to; I knew that for sure when you didn't show up last night. And it's my fault, I know that—should've kept my big mouth shut. Not that it matters anymore. I didn't want to go out with a whimper anyway; I mean, I'm not a goddamned monkey you know. But I can't let you risk your career trying to save me especially when it's too late already, you'd try it anyway, dumb big sister you are. Especially when it's as wrong as this. We can't just start throwing everything else out, just to save lives—even the lives of those we love. I love you, you know that? Dammit, this isn't the way I wanted to go, no one should have to go this way, but I'm too tired to come up with something better. So I'll make this short and simple. Goodbye. Good luck.

Jeff

* * *

Ejecting the disk, she dropped it on top of the pile of printout. Jeff was gone. She felt removed from herself, and was examining the paradox that was her thinking of it: the part of her that accepted it as fact, and the part that knew she could not accept it, not yet, whatever intellectual or psychological tactics she employed; and that part that said that it was not right to accept it yet. All the while, knowing that this multifaceted schizophrenic was only her way of waiting for the emotional explosion to diminish to the point where she would survive it.

The oddest part, however, was the discovery that, although she had long believed herself fully prepared for this moment, she had not prepared for it at all. That had been another delusion.

Jeff was gone.

Libby picked up the disk, popped it back in, and listened to it again—several more times, in fact—ejected it and dropped it onto the pile. It didn't make any difference. She looked at the ceiling, closed her eyes and imagined stars. When she opened them, she was in the same universe. Jeff was still no more.

She stood up, started for the door, then sat down again. No. This wasn't the time to make decisions. The rational part of her mind understood that by reflex, froze her body. Besides, it was still early; the protesters, if they were going to return, wouldn't have done so yet. What were you going to do anyway?

Jeff. Still dead.

She started to laugh. A hysterical reaction, she knew; but could no more stop it than she could stop her knee from jerking in response to the mallet's preci-

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sion tapping. Libby also knew it was nothing to worry about, that it didn't mean she was losing her mind or anything like that. That would come later.

She pounded both fists on the desk top as the realization infiltrated her brain again. Look; it's no good sitting here, you've got to—

"Yes? Who's there?"

Another series of soft raps had started, but they stopped when she answered, and the door creaked open. "I thought I heard you in here. I wanted to tell you—"

"What the hell do you want?"

Paul Gottwald's wire-thin frame stopped in mid-stride, as though he'd turned into a stick figure. His face registered shock, then disbelief, and then a sort of deep throbbing pain, the hurt of a lifetime of infinite injustices silently borne. He must have captured the agony on her own face however, for he retreated immediately, his head averted. "I'm—please excuse me, Dr. Carver. If this is a bad moment, I can return later."

"No!—I'm sorry. Don't go." It was hard to believe how utterly crushed he looked; the invincible Dr. Gottwald, the man with the sensitivity of the Great Wall. So, the man was just another Cowardly Lion. These were not exactly the circumstances she would have chosen to discover this intriguing fact. But that didn't mean she could ignore it. Rising, she went to the door, took his arm, and directed him to her visitor's chair. He acceded to her guidance like a man shell-shocked.

"Please forgive me, Paul. That outburst wasn't directed at you, I guarantee you." She even managed a pathetic smile. "I've been under a lot of strain, and—" *shut your stupid mouth, will you?*—"What did you want to see me about?"

Paul cleared his throat. "First, let me offer my sympathies concerning your brother." He looked into her eyes. "You realize, I didn't know."

It took her a moment to realize that he was referring to Jeff's illness, that of course he didn't know what had happened this morning. "That's because I never told you. I didn't want to involve anyone here with Jeff's situation. You understand."

He nodded. "I made some comments yesterday. . . ."

Perhaps, just perhaps, she had completely misjudged him. He had come from a different universe after all—different culture, heritage, upbringing, traditions. It was easy to mistake the social clumsiness of a foreigner for callousness, or to fail to see that an overbearing manner could cover for a lack of confidence in an alien world.

"Don't plead guilty to crimes you haven't committed."

"I also wanted to congratulate you for standing up to those people yesterday," he said. "Anyone who would morally equate animal research with what went on inside the concentration camps—should be condemned from every pulpit and podium in the civilized world." Gottwald's face was suddenly even darker and more somber than usual. "It is a good thing I wasn't there; I don't want to think what I might have said. Or done."

She raised an eyebrow. Why such a powerful, personal reaction? Obviously, there were things he hadn't told

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her either. She shivered, thinking what they might be; he was from the right part of the world. "Well, thanks for the support, Paul."

He frowned heavily. "It needed to be said." And having done so, rose to leave. "Your brother will be in my prayers from now on."

"Thank you. That's very kind of you." *Jesus.*

But he hovered in mid-indecision, holding on to the back of the chair as though it were a lifeline.

"Was there something else?"

He sat again, the skeletal frame rigid in the chair. She realized she could actually make out the line of his jawbone beneath the skin.

The bone moved. "I think—it may be possible . . ." He looked at her. "Your brother, I mean."

When he didn't continue she said, "I don't think that is possible." *No. Don't tell me this. Not now. For God's sake, not now.* "Believe me, if there were any line of research anywhere that held any hope, I would have found it. Believe me, I would have found it."

Gottwald's expression didn't change. "You mean, if it were in the legal databases."

"What . . . what do you mean?"

"Come, Dr. Carver. You must know that both federal and international law forbids some kinds of data from being entered into those databases. Or used in any manner."

She started to reply, but he spoke first. "As you alluded to such data in your confrontation yesterday, you cannot deny knowledge of them. Not credibly, that is."

Yes. Yes, I would use it, if I could . . . if I thought it could save my brother's life . . . but it could no longer save Jeff. Nothing could save Jeff. *(Scream that into your mind, until it stops screaming back!)* She folded her hands across her desk. "If I understand what you mean, the UN council findings which led to those laws also made it clear that the data you are referring to are of no value scientifically."

"The council did not see all of the data." He offered what might have been a smile, although the way it barely cracked over his teeth Libby wasn't sure: it seemed more a grimace of pain, like a razor blade slicing through an ancient callous. "Which was not their fault. But the data are available. They have been waiting for the proper time to be made use of. Secretly at first, although I am sure that once positive results are achieved, governments will be persuaded to reexamine their position."

She was at a loss for words. "You are talking about concentration camp experiments."

"Most of which were as disreputable as you say. But some of the experimentalists were quite competent—evil, I cannot argue—but they knew how to do science. They also had an inexhaustible supply of subjects, and no ethical restraints on what they could do. They performed thousands of experiments on prisoners: injecting them with various mixtures and doses of chemicals. And they made very methodical, very detailed observations of the results. It was very well done, very well done." He had sincere respect—or was it admiration?—on his face.

Libby gazed at her hands. They suddenly looked detachable somehow, as

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though their powers could just as easily serve evil as . . . as . . . as, whatever they served by serving her. She wasn't as certain anymore. "I'm not sure I should ask you this, but—"

"How do I know about these experiments?" Gottwald licked his dried lips. They didn't appear wetted by the action. "You're right. You should not ask. But I have no right to involve you without telling you the whole truth. Which is that one of the experimenters was my grandfather," he paused, "who was an evil man, and deserved what he got when the Polish partisans got hold of him. He was captured while trying to escape the country with the data the SS had ordered him to destroy—" he "smiled" again—"Being quite passionate about his work, he couldn't bear to see it lost. Before he was shot he managed to smuggle his journals to his son—my father—and have him flee the country, to Prague. Of course my father kept the journals hidden, fearing what the Communists would do with them, but never being able to bring himself to destroy them either. Only when the Russian tanks left in '89, that was when we decided to see whether my grandfather's work could be used to do good."

Libby shook her thick curls. What this man—this ice pick of a human being, who had never, by even the subtlest gesture, revealed any aspect of his private self to her before—was telling her was impossible, utterly impossible. She could not believe it, not objectively. Yet subjectively: if certain kinds of body language were universal, Gottwald was filling in the chapters that had been missing in every history she had ever read. "I . . . don't understand. How did you verify the data? Without being able to reproduce the experiments, how could you—or—"

For a moment, near-hatred flickered on Gottwald's features. "You think I am some kind of monster, don't you." It was a statement.

"No. God, of course not." But that was exactly what she had thought, for a moment at least. "I'm sorry. Obviously, you used animals. Pigs?"

"As much as we could. And rhesus, when we could get them. Mostly we had to work with mice and rats. It was pretty unpleasant work, of course." She raised an eyebrow. "We couldn't use anesthesia," he explained. "Have you ever seen a terrified rat, in agonizing pain? Terrible. Terrible. The stuff nightmares are made from. Makes me almost agree with the Animal Rightists."

Libby suddenly recalled her "discussion" yesterday, and found herself shrinking in horror: Gottwald had actually done what the rightist had been suggesting!

"Almost." He took a deep breath, and his shoulders slumped heavily, like a great scaffolding of bones. "Not important. Important thing is, the data are good. *Ausgezeichnet.*

"All that is left is to find the right situation, and the right people, to make use of them. We didn't have the resources at the Institute. But here . . . to be frank, I have had my doubts about you, Dr. Carver. Even after yesterday. But then I realized: if I can't trust you, I will never trust anyone, and the data will never save any lives. So I am taking the risk. Time will say whether I have chosen wisely or not."

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He leaned back in his seat, and appeared to relax, as though, his burden finally delivered, he could accept whatever reward or punishment the gods chose to bestow.

Libby closed her eyes, and tried to imagine she were somewhere else, or better, somewhen else. But when she opened them, neither act of imagination had been granted.

"Where are the data now?"

"They are still at the Institute. But they have been entered into our computer. We can transfer them here any time you wish."

She raised her head. "You mean, into our database?" Gottwald nodded. She practically choked out, "My God, are you . . . ?" Certainly he had to know that their database was subject to unannounced inspections by half a dozen state and federal agencies.

"It can be hidden effectively." He raised his open hand. "Please. This objection is also not credible. Your talent for programming is common knowledge. You could do it. You know you could."

"That's not the point!"

"Which is what? To let your brother die?"

She almost burst and told him. That's not the point either! True, if it had been Jeff's life, there would be no doubt as to her answer; maybe it would be wrong, but—

—but what? What was the meaning of ethics which demanded that human beings be allowed to die, slowly and horribly? By what definition of the word was that ethical?

She said simply, "I don't know how to answer that."

"That is because there is only one possible answer," he replied.

In retrospect, she wasn't sure exactly what happened. She hadn't felt the explosion coming, much as she should have been expecting it. But her fists were pounding onto the desk almost before the rage and futility blossomed inside her head. And she was screaming, yes—screaming like a three-year-old in full tantrum, although, somehow, the words were coherent:

Why?! Why didn't you bring this to me before? Why? WHY?!

A squall which, like all others, soon exhausted itself, and settled into a steady, relentless release of tears.

The part of her that was still rational listened to Gottwald, though it had no feelings for his words. He was apologizing. Explaining. As he said, he hadn't felt safe to approach her until yesterday. If he had known about her brother perhaps—he had tried to make her feel she could take him into her confidence, how hard he had tried! But she was always so cold to him, so distant. He assumed she didn't like him because he was a foreigner. Never did understand. But he did try. Very hard.

"Of course, perhaps it is my fault. I know I am not naturally personable. People don't become close to me very easily."

She tried to hear him, but her mind was a blur of alternatives. If he had come to her before—if she had told him about Jeff—if he hadn't been so unlikable—if she had only tried to approach him—if Jeff hadn't . . . done what he did—if she hadn't confronted those Animal Rightists, then she would have remembered to go to him last night—then

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he wouldn't have—then Gottwald wouldn't have come to her—then Jeff would have died anyway—and she would never have known—then more people would have died unnecessarily—

"What did you say?"

He repeated himself. "But I am not blaming you. I suppose, I perhaps have more of my grandfather's disposition than I like to believe."

Or perhaps you have had too much to hide. She could see how that could make a man be the way he was.

God, how stupid and unfair she had been!

The price for that stupidity, Jeff had paid.

She dried her face. There would be more crying later, she knew, but now she had to possess all her resources. "I suspect," she said when she had finished, "The distance between your grandfather and any of us is less than we like to believe."

"Perhaps."

The pause that followed was mutually uncomfortable.

He said, "You have not yet given me your answer."

She blinked back returning waters. "It's not right."

"The only thing that is right," he answered, "is that my grandfather was shot."

"No, that's not what I mean." She looked at Gottwald. No. There was no point in telling him. "Never mind. Look: I can't—I need to be alone."

He stood up again. "I could see that when I came in. Well, I won't trouble you with my burdens any longer today. But I will need your answer sometime, of course."

She nodded. "Of course."

She got out of her chair, drifted over to the window, looked down on the street. The protesters were beginning to set up their pickets. From time to time, one would stop and look up at the building, a nervous expression that appeared to be searching. Once or twice she even thought eye contact had been made. She could not pick out the man she'd confronted yesterday however.

That memory triggered a cascade, until she reached this morning and MacReady. *This morning?* If someone told her that it had been a hundred lifetimes ago, she wouldn't have disputed them. It felt as though a universe had been born, aged, and died since that telephone conversation had taken place. A dozen universes.

And it wasn't even noon.

And Jeff was still dead.

Somehow, she felt dead now, thinking about it. As though dying were just another event in life, a petty annoyance which you got over with as quickly and as painlessly as possible. It suddenly occurred to her that she had no idea what would happen now. Shouldn't she be talking to someone at the hospital about Jeff's bo—? What about funeral arrangements? Was there a will? Who was supposed to take care of these things anyway?

It struck her as odd only now. They had never actually talked about his dying, as though it were really going to happen. They had never discussed what to do, or made any preparations. Oh, they had mentioned it often enough, but always with a light or even jocular air.

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As an inevitable truth, it had never really entered into their interactions. Which, now that she looked back on it, had been their way of handling it without becoming suicidally depressed.

And yet, in the end Jeff had taken that ultimate step himself. So he must have given it a lot of serious thought. He had simply never shared those thoughts with her. He'd been protecting her, she saw now; protecting, first with his jokes, and then, when humor became too much of an effort for his failing body, with his cynicism and anger. His rage against the dying of the light.

And then, when he could no longer protect her even with that, he'd done so by that which he'd denied so passionately for so long.

It didn't make any sense. Or maybe it did. She didn't know anymore.

The phone jolted her. What now? "Carver here."

But she could barely hear even her own acknowledgement over the din which erupted from the receiver. A cacophony of frightened and angry voices was suddenly filling her office. "What the hell is—"

"Dr. Carver, this is security," a man's voice struggled against the tumult, attempting to sound calm and in control. "I think you'd better come down to the receptionist's area. Right now." The man said something else, but a voice with a distinct accent inundated the discourse with some words she didn't understand. "Is Dr. Gottwald there?" she demanded.

"I think you'd better just come down here."

A minute later the elevator door opened to pandemonium.

She remembered the banners and placards. Whereas yesterday they had been held up defiantly, now they were as flat against the ground as the bodies that had been holding them. As for those bodies, the plural was no longer appropriate: they had linked hands into a single, sprawling lattice of unmoving flesh, into one organism, the cells of which were spread across the carpeting. It was a living gantlet, one that the authorities were going to be hard-pressed to dissect.

That was not where the commotion was coming from however. A small ring had been cleared around the receptionist's desk: in one corner stood Paul Gottwald, his eyes hot, his wiry tense muscles twisting against the uniforms which restrained him; in the other, the rightist she had confronted yesterday—Deshea—struggling with equal fury but motives which only became obvious when he spotted Libby in her sanctuary.

"Tell—your—god—damn—goons to let—god damned—go of me! I'm not a criminal!"

Gottwald was also shouting, but she didn't understand his words.

"Release him!" she barked. Then, "I mean, release them."

To her surprise, the guards obeyed without hesitation. Not to her surprise, Gottwald didn't take advantage of his sudden freedom; she hadn't really believed his threats before. But neither his glare nor his muscles relented from their target.

The two men did nothing while she picked her way through the gantlet. She passed Gottwald without a look, and faced off with Deshea, whose lips were

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purplish. "Do you mind telling me what this is all about? I thought you said you people don't want a fight." She motioned at the bodies surrounding them. "Well?"

The man didn't back down. "The guerrilla stuff wasn't my idea. I came here to see you. Your receptionist refused to even call you, and then these—people—started roughing me up."

She turned to what looked like the most senior of the guards.

"He demanded to see you, ma'am. Wouldn't give no ID though; no name or anything like he ought t'be allowed to. When we told him t'leave, he got—got the way you see him. Then when Dr. Gottwald showed up, he went after him."

She tried to blink away the confusion. "What? Who went after whom?"

"Why, after the doctor 'course."

"That's not true!" The color of Deshea's lips was spreading to his face. "I was the one attacked! I was—"

"Shut up!" She silenced the man with a glare, then spun to Gottwald, whose response—a morose lowering of his eyes—settled the question.

Back to the guard. "How did the rest get in here?"

"They got in while we was busy with the fight this guy picked."

"This guy" was not Gottwald. She sighed, decided she couldn't damn loyalty. She returned to Deshea. "You realize that you're trespassing."

"And you're encouraging the murder of innocent lives." He took a breath and raised his head, so that she could practically see up his nostrils. "Sometimes, lesser laws have to be broken in order to obey greater ones."

Yes, that's true. She started to say her next thought, then realized it would have been a mistake to do so here and now. "You said you wanted to see me. Will my office do?" She turned to Gottwald. "As for you, I expect you to join us. Peace pipe smoking time."

Both men were too chagrined to make objections, as was the senior guard when she told him not to let the police break up the demonstration under any circumstances.

When they were all in her office, she closed the door tightly and sat down. "I was going to offer to drop all charges if your people left peacefully," she said before either of them could speak, "But on the way up I realized there's no way you would agree to that even in private. So I have another proposition."

Gottwald was the first to respond. "Please tell me what exactly I am here for. You know what I think of this man." He used his thumb in a near obscene gesture.

She glared at him. "You're here because sometimes you have to sit down with the devil. Maybe you are too used to devils that are so bad that you can't sit down with them. I don't know. But I do know—I'm willing to bet, that this—that this devil isn't in that category. In fact, I don't think Mr. Deshea here is a devil in any category. But, like a lot of people, he may be someone who has never had to face the logical consequences of his views; and probably never expected to."

"You're here mainly because you're involved in the proposition I'm going to make," she added quickly, when she saw he was about to protest her glib

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words. "Mr. Deshea?"

"I'm listening," Deshea said, although his eyes were suspicious. "But I hope you don't think you can buy me off, or—or whatever it is you have in mind. If so, you're making a big mistake."

Libby realized Deshea had picked up on the word "proposition" the wrong way. In a way that angered her for its assumptions. "Believe it or not Mr. Deshea, we in the business world are not all unprincipled bottom liners who would carve out kittens' eyeballs if there was a buck in it. In fact, you and I are not all that far apart in our thinking. Mostly, we just draw the line in different places—or are you against using worms and bacteria in experiments also?"

"Make your proposition," Deshea said, his lips tight.

She nodded at the concession. "Thank you." She looked at Gottwald momentarily. "Paul, you're not going to like this but . . ." She swiftly recapitulated enough of Gottwald's story that he couldn't stop her before Deshea was permanently and fatally informed.

"Dr. Carver! Have you taken complete leave of your senses?!"

She ignored Gottwald. "You asked me the question yesterday, Mr. uh—actually, I'd prefer to use your first name." She knew he'd mentioned it yesterday, but it hadn't stuck.

Deshea was still in a state of semi-shock at what she had told him, his lips half open. "Huh? Oh. Greg."

She leaned across the desk and took his hand. "Nice to officially meet you, Greg: I'm Libby. This is Paul." There was no offering from that corner however, only a look of disbelieving disgust. Libby shrugged and leaned back. "The question you asked me: about using concentration camp data. Now it's your turn Greg. To answer it."

Deshea glanced over at Gottwald, then back at Libby. Then he looked at the hand she'd just shaken, as though it were contaminated by something. "I'm not sure I even believe any of this," he finally said.

"Then you are an idiot in addition to being a fool," Gottwald proclaimed. "The worst kind. And worse, with followers."

If you haven't got anything constructive to say, shut up! The way Deshea was reddening, this peace conference could turn into a brawl at any moment; which, considering what knowledge he would walk (or be carried) away with, would mean absolute and total defeat for them.

Fortunately, Deshea kept his anger at manageable levels. "All right then, I give up: why are you telling me? I'd have thought you would want to keep something like this secret."

"We do," Libby assured him. She tried not to feel disappointed; after all, it wasn't as if what she was up to was obvious. Even Gottwald looked thoroughly perplexed—although that only meant he'd started to wonder if there was a method to her madness. *Hang on Paul, hang on. It's coming. Though you might not like it when it gets here.* "But why should we worry about you telling the authorities? I thought you made it very clear yesterday that you have no objections to human experimentation to benefit humans." She waited for the flash of protest to arrive on Greg's face.

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"Which is exactly what you're faced with. Well?"

He'll think I'm setting a trap, she suddenly realized. Why not? That's exactly what she would be thinking right about now, if she were him. *How will I convince him?*

As if on cue Deshea said, "I have to admit, what you're telling me is pretty hard to believe. I assume you're prepared to offer some evidence that this alleged data really exists?"

She turned to Gottwald. "Paul?"

Whose expression matched his answer: "You must be crazy."

"Thanks, Paul." She returned to Deshea. "That's my evidence: the world's greatest liar." She saw Deshea's lips purse then curl a few millimeters at the edges. *Someday,* she decided, *we're both going to have a good laugh over this.* She hoped. "Seriously, no; I can't give you any evidence. That I'm not trying to set you up, I mean," she added hastily, causing one of Deshea's eyebrows to rise. "All I can do is ask you to proceed as though what I'm telling you is true. Or, you can walk out of here right now. The decision is yours."

There was a certain point—she wasn't sure exactly how she recognized it—when the silence in the room conveyed that decision.

It felt as though it was the first breath she'd taken in that last fifteen minutes. "You haven't been contacted by someone called MacReady since yesterday, have you?"

Deshea's mouth opened slightly, momentarily. "Uh, as a matter of fact . . . I talked to him this morning, before I came here. How did—you mean, you're the person I'm going to be debating with?"

"It would appear so." She smiled, understanding exactly what was causing the consternation in Deshea's eyes. "Pretty rotten of MacReady not to tell you, isn't it? I mean, once I start talking about my brother, there isn't going to be too much you can say that will make a difference to all those millions of people. And remember, the Co-Human Life bill was passed by an awfully slim majority; a majority that, according to every poll I've seen, isn't getting any larger. Perhaps even smaller—but you know that: that's why you accepted MacReady's offer, isn't it?

"But how would you like to debate someone else?" she continued before he could reply. "Someone who wouldn't be anywhere near as impressive—whom you could beat on rhetorical and emotional points? Someone who," she finally turned to Gottwald, "could use a few sharp lessons on how to win friends and influence people? Someone who would profit from your victories over him?"

From Gottwald's expression, one would have thought someone else had been the object of Libby's proposition.

"Well? Paul?"

Gottwald's answer began with a slow, ceremonial rise to his feet. "Now I understand," he said, not addressing anyone in the room, except, possibly himself. "Now I understand. The director at the Institute told me I was making a mistake to come to the States. He said Americans were the craziest people on the face of the Earth. Even crazier than Russians. But I didn't believe that—I couldn't believe that. How could the Americans have done all they have done

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if they were that crazy, I argued? But he just shook his head.

"I thought that meant that I had won the argument. Now I see that he was right, however; and all I had done was to touch upon one of the great mysteries of the universe. For all you Americans have accomplished in your few centuries, you are truly the craziest race of people that has ever existed." He looked directly at Deshea, or through Deshea; it was difficult to tell. "You create the finest technologies in history for saving human lives, then you decide that rats and pigs are more important." Inhaling, he gave Libby the same treatment. "Then, when you are faced with the consequences of this absurd and evil philosophy, instead of opposing it, you make 'deals' with it—and worse, you drag in third parties whom you should know would want nothing to do with it."

Gottwald again detached himself from the other human occupants of the room. "The director was right. You are all insane and incomprehensible. I think—I see no alternative except to return to Prague on the first available flight." He gave them one last look. "With that, I bid good day to you." And turned to leave.

He did not reach the door.

"Damn it, Paul! If you walk out of here, you are the most, most—most gutless—excuse for a human being I've ever known." Gottwald stopped, but he did not turn. "Worse than your grandfather even," she spat out, the words ejecting like hot magma, "At least what he did had some . . ."

She ran out of words at that point.

Gottwald turned.

"How many human beings will have died horribly for nothing if you leave?" she found some more. "Not to mention the ones who will die because your 'sanity' won't let you do the rational thing?"

Jesus Christ. Here it comes; hang on girl. . . .

"What do you know?! What the hell do you know about it?!" The ascetic frame took measured steps toward her. Somehow, in retrospect she wasn't sure, she got a hold of Deshea's arm and stopped him from an instinctive response without a word. Even if Gottwald did hit her, that would be infinitely preferable to the two men really squaring off (although, she couldn't keep the small part of her mind from wondering who would come out the winner of that confrontation; or the smaller part which felt flattered and even, yes, proud, at having a man rise to her defense).

"I don't know, Paul," she conceded. "I admit that. But I do know that you gain nothing by leaving, and everyone loses everything. And besides, if you'll bother to actually examine my proposition, you'll see that I am offering you the opportunity to confront your evil directly—that that's what you're walking out on. And if you do, I have to wonder why. And the only answer I can find is that you're afraid."

"Afraid." Gottwald's lips pressed hard together.

"Just like you were afraid to tell me about the data. Just like you were afraid to stand up to your opponents at the Institute, when they blocked your work." That hadn't been hard to figure out. "Like you were afraid of you and your family being condemned for not

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destroying the data; for being Nazi sympathizers, like your grandfather. Like you were afraid of what the Communists would do if they got hold of the data.

"You've always been afraid, Paul. You've become so accustomed to it, you don't know any other way of operating. Of existing. Now you want to run back to Czechoslovakia. Run away and hide again. But what will that accomplish? Sooner or later your secret will catch up with you again, and then where will you go? Outer Mongolia?

"I'm offering you the opportunity to stop running, and start fighting. But to fight is to risk being injured, even destroyed. Look: I'm not at all sure that what I'm doing is the right thing. Hell, it's not even a calculated risk. It's a gamble, pure and simple. But, unlike you, I can't run. I don't—I guess it's not in my nature, or whatever. Or maybe I don't have as much motivation as you. I mean, I have no right to judge. But I am saying what you must know: if you run, I lose my gamble, and everything that I've staked on it. And not just me. Everyone."

She finally released Deshea's arm. He rubbed the imprinted flesh.

Gottwald's reply told her she had won the battle. If not the war. "And us," he motioned at Deshea, but fortunately made no other moves, "What do we gain from your deal with the devil?"

"You mean, it isn't obvious? If we're going to work with that data of yours, we can't be having media types swarming around, watching and investigating our every move. Which they will, as long as the protesters keep turning us into a magnet for that kind of attention. Well, in turn for having you to deal with on MacReady's show, instead of me and . . ." She stopped, knowing the rest was self-evident. "Besides, I can't very well be a full-time public crusader against animal rights extremism—whatever else I think of you, Greg, that's exactly what you are—I can't do that and engage in illegal, secret research at the same time; I have to stay out of the spotlight as much as possible."

Gottwald was shaking his head. "You are crazy. Don't you see, you're giving them—these people—the power to have us all arrested any time they decide. Or blackmail us. What's to stop them—"

"The power to destroy our credibility any time you want," Deshea answered for her. He nodded in admiration. "If it ever came out that the animal rights leadership made secret deals with a pharmaceutical company, over something like this, the movement will disintegrate overnight. It's our impregnable moral stance that's given us our power."

"But that moral fortress won't withstand too many Jeffs," she said.

"On the other hand, if I reject your proposition, I'm a hypocrite. You've backed me into a corner of my own making—if this data of yours is real, that is. Assuming that it is—" Deshea gave a long, thoughtful look, then extended his hand. "It's a deal." Then he turned to the still standing Gottwald, hand still offered. "See you on MacReady's show?"

"If and when I decide to do that, you will no doubt be informed," was Gottwald's only reaction.

Deshea lowered the hand. "OK, I

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guess I'm asking for too much. But if he's not there, don't count on this conversation staying secret."

Libby nodded. "He'll be there. Don't worry." She glanced at Gottwald, who showed no reaction. "Now, if you don't mind—" she went to the door and opened it fully—"The police have no doubt already arrived, and I wouldn't count on our guards to restrain them forever."

When Deshea had left, Gottwald said, "You should not have told him about the data. That was a mistake."

Libby shook her head. "If I had tried using only bullying tactics, he would have told us where we could put what. Don't you see that he accepted because he wants me to use your data? In other words, that he's not the devil you make him out to be? Or the fool?"

"If anyone is the fool . . . and thus, I should correct myself. I should never have told you about the data. That was the mistake."

She sat down again. "No Paul. That was your gamble. You had to take one eventually." She picked up the phone, recalled the proper number, then nailed him again. "Personally, I think this one is going to work out just—hello? Yes, I'm trying to get hold of a Mr. MacReady. This is Dr. Carver calling. He's expecting—yes, thank you."

She heard MacReady's voice a moment later, but placed a hand over the receiver. "This is your last chance to back out, Paul. Speak now, or forever hold your peace. Or perhaps I should say, not hold your peace."

Gottwald started, then closed his mouth.

"Hello, Mr. MacReady? There's no need to shout, I can hear you just fine. No, just a frog in my throat for a moment. Yes. Yes. I have. Well, not exactly. No. What I mean is—well, maybe the best way to do it is to put him on the phone. . . ."

She waited for them to finish, then took the receiver from his moist, trembling hands. "I know you won't believe this, but I thought you handled that very well," she said.

He snorted. She wasn't certain, but she thought she caught a trace of that razor-blade smile on his lips.

She swung over to her terminal. "Now the next step: just where exactly is this data of yours anyway?"

Jeff would have liked the funeral. Small, tasteful, to the point. Even the eulogy was just right—zero time wasted on zero words. There was no viewing of course; no open caskets or other absurdities intended to make people think he still existed in any way save for their memories. Besides, there wasn't much left to put on display; in accord with the "living will" he'd made over a year ago—something else he'd concealed from her—the hospital had removed every usable organ and tissue from his body before releasing it to her. As for the rest, the flames handled them quickly.

A flickering newspad in a window caught her attention as she headed home. The Animal Rightists were finally introducing their bill to ban all research which used data obtained from animal experiments. The impression she got from the various commentators was that a bitter and protracted battle lay ahead, with victory for either side

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being decided by the slimmest margins.

And that was just one battle in the war.

Sometimes she wondered if that war was already over, that the decisive battle had already been fought. And lost. For after all, hadn't she given Deshea exactly what he was fighting for? Human suffering for human benefit. Hadn't she conceded his morality over—

—over whose? What was her morality, anyway? The ends justify the means would seem to describe it best; to describe it honestly, that is. It didn't matter where the data came from, or how it was collected, as long as future Jeffs could be saved. Because it could have saved her Jeff.

In short, the morality Jeff had opposed by his choice to die.

Of course, it had been easy for Jeff, just as it was easy for Deshea and the rightists. The power to save lives wasn't in their hands, after all. It was one thing to tell doctors and scientists what to do with their skills; quite another to fold your own hands, to close your own eyes.

The printer was silent when she opened the door, but the layer of fresh printout on the floor beneath it told her that her program had completed its run successfully, that is, it had produced output. Whether it was useful output or merely Garbage Out however, would be long hours and several doses of something for tension headaches.

She had dinner, took an extra long, extra hot bath, and went to work.

It was the wee hours of morning when she knew she had succeeded.

Of course it wouldn't bring her brother back. Nothing could do that. There was no way out of that hell.

But hopefully, Jeffrey's story would never have to be told again. ■

●The mentality still exists that buying the hardware and software will create the data.

submitted by H.D. Benton

●Children have a lot more to worry about from the parents who raised them than from the books they read.

E.L. Doctorow

●Thomas Jefferson warned: "The most important reason for the people to retain the right to keep and bear arms is, if necessary, at last resort to protect themselves from tyranny in government."

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Unquenchable Fire, Rachel Pollack, Overlook Press (149 Wooster Street, New York, NY 10012), $23.95, 390 pp. (ISBN: 0-87591-447-7).
The Silent City, Elizabeth Vonarburg (Jane Brierley, trans.), Bantam, $4.99, 261 pp. (ISBN: 0-553-29789-9).
The Turing Option, Harry Harrison and Marvin Minsky, Warner, $21.95, 422 pp. (ISBN: 0-446-51565-5).
Unwillingly to Earth, Pauline Ashwell, TOR, $3.99, 280 pp. (ISBN: 0-312-51929-9).
The Gypsy, Steven Brust and Megan Lindholm, TOR, $18.95, 259 pp. (ISBN: 0-312-85274-6).
Nebula Awards 26, James Morrow, ed., Harcourt Brace Jovanovich, $24.95, 300 pp. (ISBN: 0-15-164934-0).
Whatdunits, Mike Resnick, ed., DAW, $4.99 335 pp. (ISBN: 0-88677-533-7).
More Whatdunits: The Editors Strike Back, Mike Resnick, ed., DAW, $4.99, 320 pp. (ISBN: 0-88677-557-4).
Cybertexts, Bruce Boston, Talisman (Box 321, Beech Grove, IN 46107), $5, 40 pp. (ISBN: 0-9626708-4-5).

Rachel Pollack's first novel, *Alqua Dreams,* considered the place of mystic intuition in a world that strikes many as far more explainable by materialistic rationality and wound up demonstrating that the two mind-sets can be equally incontrovertible. Now, four years later, those of us who are not aware that Pollack also writes on Tarot and fortune-telling discover that she prefers the mystic mindset. Her demonstration of this preference takes the form of a remarkable novel that could be called fantasy, magic realism, surrealism, and even—if we strain just a little—science fiction.

The novel is **Unquenchable Fire.** The setting is America generations after an uprising of supernaturally empowered people, the Founders. Behind these shamans and witches (there are perhaps no better words) lies the Living World, Nature personified but more than that. About them have been woven creation myths and tales—or Pictures—that portray the destruction of our familiar world and the emergence of a new one in which magic is everywhere. There are tutelary deities, totems, lares and penates, gods and goddesses. There are relics and rites, and when the priests, or Tellers, tell the Pictures, people's souls leave their bodies and miracles occur. Or so they used to do. The priesthood has grown lazy and complacent in its comforts. Magic has diminished in the hands of bureaucrats. Pollack's world actually feels quite familiar, with suburbs and commuters, malls and shoppers, friends and lovers, differing mostly in the magical, ritual details.

Now meet Jennifer Mazdan, whose job is to polish the idols that bring en-

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ergy from the sun to power Poughkeepsie. She has a history of being present when strange things happen, and her husband, unable to stand the scent of miracles, has annulled their marriage and restored her official virginity. The famous Teller Alan Lightstorm is due to arrive soon to tell a Picture for a holiday. Like everyone in town, Jennifer is looking forward to the occasion. But as she finishes her work that day, a vision overcomes her. She passes out in a parking lot and misses the show.

Later, at the dream registry, she learns that no element of her dream has ever been recorded before (even though the reader may recognize the significance of such things as fish). Later still, she learns she is pregnant. Having had nothing to do with men since her husband left three years before, she is understandably upset. She tries to visit an abortion clinic, but trees and bushes spring up to block her path. Clearly, something wants her to have this baby.

What is that something? What else but God or the Living World or whatever Powers rule. So say the omens her mother finds in a New York deli, and the amateur Tellers she overhears from the street, and the chocolate-chip cookie salesman who seems to be a divine messenger. Magic, full-fledged and potent, is on its way back to the world no matter how much Jennifer objects to being manipulated by Higher Beings for Higher Ends. Pollack kindly gives us a few glimpses of the child grown up to prove the point.

Whether you agree with Pollack's New Age orientation or not (I don't), you have to admire her accomplishment here. She has torn down not only the world of materialism but also the standard visions of fantasy and then created—or recreated, grown anew from the roots of myth—something new and fresh and wholly, deeply familiar.

"Unto them a child is born" could have been the epigraph for Pollack's book. It would be equally apropos for Elisabeth Vonarburg's first novel, **The Silent City.**

Vonarburg teaches at the University of Quebec and writes in French. Her language helps explain why we have seen so little of her short work in this country. She needs to be translated, as she quite ably is in this case by Jane Brierley.

Vonarburg's future is some centuries after the collapse of Western civilization. All that remains is the underground enclaves known as Cities in which decadent leaders and tycoons took shelter from disaster. They had hoped, with the aid of rejuvenation treatments, to wait out the time until comforts were once more available on the surface. But the years rolled on. Rejuvenation treatments reached their limits. The Cities' residents aged and died. And they did not have enough children to replenish their numbers.

The story opens not long before the end. Here is Paul, one of the few born in the City. A biological engineer, he has identified in the savages outside the City a mutation that permits regeneration and may hold the promise of a natural and perhaps unlimited rejuvenation. He uses ommachs ("humanoid machines," robots) to take samples, and in time he produces Elisa.

The few remaining residents of the City die, leaving no more than computer simulations of their personalities. Elisa and Paul live on, and it emerges that Elisa can not only regenerate but also change her body form, even to the point of becoming male. She goes among the savages as a man, Hanse, mates, and discovers the extent of Paul's cold-

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blooded manipulations of the people outside the City. Later, alone, she becomes both mother and father to a tribe of children who in time will—she plans—spread her miraculous genes among the Outsiders.

The world outside the City is a depressing place for a woman. A virus has greatly skewed the male-female birth ratio, and a surplus of women has made that gender a valueless commodity, oppressed and suffering. Elisa's mutation holds great promise, for if it ever spread worldwide, it would permit a woman to be a man (and vice versa) if and when she wished. That would guarantee equality more effectively than arguments or revolutions. Or would it? It holds that potential, but, says Vonarburg, "we feed ourselves incessantly on dreams, illusions, lies that are forever renewed."

There is passion here, but it is a passion of the head rather than the heart. Vonarburg's tone is cool, and her story is a series of set pieces with actors posed to make her points. She thus seems to owe more to Europe's literary traditions than to the U.S.'s.

That's no surprise. I've seen the same thing said of Canadian—or was it only Quebecois?—literature in general.

Harry Harrison is a very well known SF writer with a long list of credits. Many of his books, indeed, are excellent examples of how to blend thoughtful extrapolation with adventure and leave the reader both satisfied and edified. Marvin Minsky is a maven of the field of artificial intelligence, more given to academic papers than to novels.

What do you get when you put them together? A package called **The Turing Option,** and if you know who Harrison and Minsky are, you hardly need to recognize Turing's name to anticipate cutting-edge extrapolation, the invention of a genuinely intelligent machine, and headlong adventure to carry it all. It starts off well, too. The first chapter introduces the Megalobe corporation, where computer whiz Brian Delaney has just announced a working AI. J. J. Beckworth, Megalobe chief, has just come to the lab for a demonstration. And suddenly . . . When the smoke clears, the AI is gone along with every scrap of Brian's computer gear. Brian is apparently dead of a bullet through the brain. The security forces have vanished. And of Beckworth there is no sign except one drop of blood.

Enter neurosurgeon Erin Snaresbrook. She is prepared to try a number of brand-new techniques to save Brian. One of those techniques involves replacing the destroyed brain tissue with a spliced-in computer and using programming to restore lost intra-brain connections. When Brian finally wakes up, however, he proves to have lost ten years of his life, education, and work. Fortunately, the computer has vast capacity and its memory can hold textbooks and databases galore. This helps immensely. As soon as Brian is able to function, he manages to track down a hidden, partial backup of his notes and reinvent his AI, only better. There are further attempts to kill him. There is betrayal. And the AI, called Sven, finally helps track down the villains and arrange a final confrontation with the mastermind.

That's it. There is a final touch of pathos designed to emphasize that humanity is not necessarily a matter of flesh and blood, but that's it. The whole story might have fit comfortably into the frame of a novelette or novella or—if the authors could add some depth to their characters—a much shorter novel.

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What bloated it past 400 pages was great wads of nearly indigestible exposition on the subjects of intelligence, brain structure and function, the mechanics of how brains and computers might interface, and so on. It's nifty enough stuff, but I think it would have been better handled as a science fact article or two, perhaps even for this magazine.

Is the intended audience for this book all those people who wouldn't go near a science fact article? Then the book is no more than a candy-coated lecture. Or is it a distinguished academic's only way to speculate without arousing the frowns of sober-sided peers?

Either, perhaps. Or both. But not SF worth recommending as SF.

Pauline Ashwell (aka Paul Ash) has been contributing to this magazine since the late '50s. In all that time, there have been no novels—but to everything there comes a time. Ashwell's first novel, **Unwillingly to Earth,** is now here.

Is it really a novel? Well, it's a fix-up, a book whose parts have appeared as separate stories. It therefore lacks the continuity and development of a true novel. But SF has applied the "novel" term to many books of similar construction, so we'll let that pass. The story is that of Lizzie Lee, a bright hick-planet kid who attracts the attention of M'Clare, head of the Cultural Engineering program at an Earth college. Lizzie is therefore off to school, where she gets educated, has adventures that show off her own brash intelligence and the principles of Cultural Engineering, and eventually graduates. The pattern is that set by Heinlein's Podkayne (among others), female competence and independence to a degree worth applauding considering the 1958 date of the opening segment ("Unwillingly to School") and the 1960 date of the last ("The Lost Kafoozalum"). The more recently written segments (1982's "Rats in the Moon" and 1988's "Fatal Statistics") maintain the pattern and provide a salutory sense of this magazine's continuity and history.

The book's greatest weakness has to do with the changes our culture has undergone since 1960. At that time, it might have been acceptable to suggest that the proper destiny for the spunkiest, cleverest, most intelligent, and most independent gal around had to involve wedding bells and happily ever after. Today, that suggestion must strike many as archaic. Ashwell would have done better by herself if she had extended her "fix-up" to include a bit of rewriting.

In the last few years, fantasy writers have discovered that there is a great deal of mileage to be gained by bringing their material into the modern world. The result has been called "urban fantasy"; it is just as broadly varied as more traditional fantasy, with room in it for Esther Friesner's comedies and Charles de Lint's mystic mood pieces. Unfortunately, far too much of the subgenre involves punk elves, ogres, gnomes, and unicorns with attitudes. Far too little genuinely opposes the ancient lifeways and worldviews suited to a pretechnological world to those suited to our time's concrete canyons. That which does gains much from the tension we all carry, rooted in a nervous system that evolved in that pretech world.

Some writers are more successful than others at tapping that tension (no one has yet tapped it perfectly). Two are Steven Brust and Megan Lindholm, and they prove it in **The Gypsy.**

Our world, say Brust and Lindholm, stands upon the limbs of the tree that is

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the world below and is roofed by the roots of the world above. Few can see limbs and roots, but they are real, and sometimes people and things can move from one to the next. One such person is the Fair Lady, who has covered the world below in darkness and pain and now wishes to do the same with ours. She recruits our fellows to do her bidding, and none oppose her.

Or do they? As *Gypsy* opens, a gypsy is ducking into a bar to avoid sirens. Why? He isn't sure, for his memory has great holes. Still, he knows enough to duck and he has strange gifts of insight and foretelling.

The cops, Stepovich and Durand, get him anyway. They toss him in a cell and walk away, sure they have caught the hoodlum who shot a storekeeper. He had no gun? No matter. He had a knife, didn't he? Well, where is it? Why, somehow in Stepovich's pocket, and his young partner smells that Step's turned bad, while Step's daughter Laurie, who lives with Step's divorced wife, is being tempted into the Fair Lady's clutches.

Now where's that gypsy? Not in the cell, that's for sure. He's on the street somehow, muzzily realizing that he must not eat or drink or sleep—he's a Taltos; he needn't—while he, the Dove, seeks his two gypsy brothers, the Owl and Raven, and the Coachman who can transport them from world to world and somehow tries to fulfill his long-delayed mission, to expel the Fair Lady and her minions from our world. In due time, we will meet two gypsy ladies, ancient fortune-tellers, and learn that Step, the Wolf, is an essential ally in the struggle, as is his retired colleague Ed, the Badger.

As usual, the outcome is predictable. But getting there is a pleasure due partly to the play of song, fiddle, and tambourine through the tale and partly to one particular character. Not a gypsy —they're familiar. Nor cop, human, or devil. But that Coachman, lord of the open road, a mythic figure from the dawn of civilization when roads meant freedom. A figure that speaks to the soul of every science fiction reader who dreams of long light years passing, far worlds, strange peoples, wild adventure, and no matter that a coach has wheels and horses and a starship has a keel and perhaps a sail.

Where did that starship come in, you ask? This is fantasy, yes, but it breathes a spirit congenial to the SF reader too. A spirit that Heinlein tapped when he named a story "The Roads Must Roll." Now Brust and Lindholm have given SF its gypsy god.

James Morrow has done an excellent job of assembling **Nebula Awards 26,** the latest volume of stories (or authors) chosen for recognition by the members of the Science Fiction and Fantasy Writers of America. The year in question is 1990, and the stories are generally quite memorable enough to deserve the attention. Here are Ursula K. Le Guin's "The Shobies' Story," Terry Bisson's "Bears Discover Fire," Ted Chiang's "Tower of Babylon," Pat Murphy's "Love and Sex Among the Invertebrates," Ian MacLeod's "1/72nd Scale," Karen Joy Fowler's "Lieserl," Martha Soukup's "Over the Long Haul," Dafydd ab Hugh's "The Coon Rolled Down and Ruptured His Larinks, A Squeezed Novel by Mr. Skunk," and Joe Haldeman's "The Hemingway Hoax." There are also the poems, by G. Sutton Breiding and Patrick McKinnon, that won the Science Fiction Poetry Association's Rhysling Award, Bill Warren's evaluation of 1990's movies, and Kathryn Cramer's recap of the year in our field. George Zebrowski provides

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an "In Memoriam" for Donald A. Wollheim and Terry Brooks salutes Lester Del Rey.

This one provides a valuable overview unmatched by any of the "Best of the Year" anthologies. If you don't want it for yourself, urge it upon your local and school libraries.

One of the saddest truths about writers is that they are dangerous people, given to fits during which they forget what they are supposed to be doing. It is thus something of a miracle that they ever live to old age. It is also something of a miracle that anyone ever lets them have the car keys.

Kidding aside, writers are often overcome by what anyone else would call weird ideas. Then they say something like, "Oh, wow! I wonder if I can con an editor into buying *that* one!" And sometimes they do.

Kidding aside, a while ago, Mike Resnick thought it might be interesting to make up a bunch of murder-mystery scenarios along the lines of "An alien, here to study our native animal life, is killed by same. To people who know animals, the attack may even have been justified. A detective from the alien's race now arrives on Earth, determined to prove that this attack by unthinking animals was murder. The men in charge of the animals . . . must prove to an alien who cannot even differentiate between a simian and a human that their animals are innocent." He then recruited a suitable quorum of science fiction writers to write stories from his scenarios, wrote brief introductions that included the initial scenario for each story, and sold the package to DAW as **Whatdunits.**

Roger MacBride Allen got the scenario I spelled out above, handled it to humorous satiric effect, and wound up with "Monkey See." The other contributors include Pat Cadigan, Jack C. Haldeman II, Anthony R. Lewis, Katherine Kerr, Laura Resnick, John DeChancie, Judith Tarr, Michael Stackpole, Ray Aldridge, Rick Katze, and Esther M. Friesner (with husband Walter J. Stutzman), along with half a dozen more less familiar to SF readers.

Most of the stories are at least competent. None are potential prize-winners. The biggest problem may be that when writers work on other writers' ideas, they do less than their best work, or it may simply be that murder mysteries are burdened by an excess of formula, especially at shorter lengths.

On the other hand, the book's publisher was enthusiastic enough to tell Resnick to do it again, only this time with writers who are or have been at some time in their careers (however briefly) editors. The result was **More Whatdunits: The Editors Strike Back,** which will be available in a few months. The contributors of the book's nineteen stories include the obvious—Stanley Schmidt, whose "Worthsayer" (about an alien who is murdered despite its supposed precognitive ability) could easily have fit in this magazine; Beth Meacham (TOR); Kristine Kathryn Rusch (Pulphouse and *F&SF*); Patrick Nielsen Hayden (TOR); Josepha Sherman (Baen); Brian Thomsen (Warner/Questar); and Ginjer Buchanan (Ace). There are also the less than obvious—myself (I was a textbook editor from 1972 to 1976), David Gerrold, Barry N. Malzberg (whose "Lady Louisiana Toy" I found stylistically maddening and irritatingly opaque), Susan Schwartz, George Alec Effinger, Jane Yolen, John Betancourt, Martha Soukup, Susan Casper, Jody Lynn Nye and Bill Fawcett, Tappan King, and Janet Kagan.

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Again, most of the stories are at least competent and none are potential prize-winners. I found it interesting that many of the book's better stories are by people who are writers first, with past editorial experience, rather than by editors who write a bit on the side. Perhaps this is a sign that writers who have been editors tend to be a bit older and/or more experienced (and yes, I know there are plenty of exceptions to the tendency).

This book too tastes strongly of formula, but this is a problem that may be worst when you read the book all at once, and worse yet when you read it right after the other. It's like chocolates—eating one or two is a delight; eating a whole box in one sitting turns one green; eating two boxes at a sitting makes one bow to the porcelain god.

Buy this one to learn which of your favorite writers misspent their youth on the wrong side of the typewriter. Buy both or either to see what your favorites have been up to lately. Buy both (of course) if you're a mystery fan. But don't gobble.

By the time you read this, Resnick's *Walpurgis III* will be available from Questar for $4.99. One of his early Signet titles, first published a decade ago, it deals with the hunt for a paragon of evil in the wild and wooly galaxy Resnick has made so familiar. If you missed it the first time around, here's your chance.

Bruce Boston recently sent me his latest chapbook, **Cybertexts.** If you have any taste for science-fictional poetry, you are sure to enjoy at least part of its contents. "Against the Ebon Rush of Night" won *Aboriginal SF*'s best-poem award. "Old Robots Are the Worst" did the same at *Asimov's SF Magazine*. Among my favorites are "Ballad for a Brave New World" ("It's a brave new world, They tell me so, And who are they to lie. . ."), "In the Garden of the State" (where "we can celebrate the termination of that weed-choked individuation our antecedents called history. . ."), "Song of the Eternal Sailors" (". . . we've fled the mother world and sailed into space, As misfits, outcasts, pioneers . . . of the human race."), and "In the Eyes of the Pilot" ("The breath of many worlds sifting through her blood. . ."). Some pieces admittedly leave me cold, but there's no denying that Boston has a marvelous ear for sound and image.

AVE ATQUE VALE

I'm writing this in April, just a few days after the death of Isaac Asimov.

He had been ill for a while, so I can't say the news was a surprise. But it was saddening, an occasion for mourning and regret and reflection on what Isaac Asimov has meant to the field of science fiction.

He didn't found SF, but he certainly helped to make it what it is today. He is of special importance to *Analog*'s readers because he was one of the few remaining Golden Agers who had been shaped by the late John W. Campbell, Jr., and he was perhaps an epitome of the scientist who could write science fiction. And he wrote prolifically —some of the most popular SF stories in the history of the genre, not to mention popular science, limericks, and commentary on everything you could possibly imagine, including Shakespeare and the Bible.

Was he a good writer? What does "good" mean? He didn't go in for stylistic frills and furbelows, and his characters tended to be rather wooden, but his Foundation trilogy is still in print half a century after it was written.

Was he any good? It is time alone

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that answers that question in any way that means much, and so far the verdict is all in his favor. Nor is the verdict diminished by the influence Asimov had upon generations of writers and readers, as a model of how to write SF, as an explainer of science and technology, and as the name upon a popular magazine and a host of anthologies (including "The Great SF Stories of 19. . ." series).

Surely he will not be replaced. ■

Kelvin Throop's Dictionary of Politically Correct Usage

● **liberal** (n.): *also* **left-winger:** In the US: one who advocates greater state direction of society. In China, the former USSR, and elsewhere: one who advocates less state direction of society. Thus, those removing government controls on the Russian economy are described in the media as "liberals." (see "conservative").

● **conservative** (n.), *also,* **right-winger:** In the US: one who advocates less state direction of society. In China, the former USSR, and elsewhere: one who advocates greater state direction of society. Thus, an attempt to restore communism is described in the media as a "right-wing coup by hard-line conservatives." (see "liberal").

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BRASS TACKS

Stan:

You *will* get yacht loads of mail about Reginald Bretnor's editorial in the March issue, but I'll try to squeeze a few words in anyway. Let me start by agreeing with Bretnor's view of the Second Amendment: it certainly was meant as an individual right. That it is the only article in the Constitution that specifically explains its necessity (outside of the preamble) has led to its misinterpretation by courts who have as much to fear from it as do other government institutions. But its message is clear: people who are unable or unwilling to defend their own liberties themselves won't have them very long. And whatever you think of this view, it is hard to believe that the Founding Fathers could have had any other in mind: after all, look what they had just come through.

Bretnor is also right about this not being an academic issue. I grew up wondering how this country had managed to keep its high degree of liberty and freedom for two hundred years. Certainly democracy has helped, as has the federal system and the division of powers. But it can't be all paper and legalisms. Nor can I believe that we've been lucky enough not to have put potential despots in Washington. It bothered me terribly until one day when I read, for the umpity-umpth time, about the hundred million plus guns in the hands of private Americans. When I put this together with something rarely mentioned in school—that for most of its history, the federal government had only a small standing army—I saw what had been staring me in the face all along: the federal government *couldn't* have taken over, even if it had wanted to. It lacked the brute physical force necessary. (Interestingly, the two times it has come closest to having that physical power—1865 and 1945—the presidents who could have wielded it died at the heights of their political power; so I guess we have had our share of luck!) The point is, let's not have any illusions about what *will* eventually happen if it ever does; those who believe in the power of ballots over bullets need only go south of the border to see how well that faith works.

After that, I have to diverge however. Bretnor makes some good points about guns as a defense/deterrence to crime, although in most cases there are better and safer methods. And let's not gloss over the fact that no punishment can deter unless criminals are *swiftly* and with a high degree of success apprehended and convicted (while protecting the innocent!). Even without *Miranda* this would not be easy, although people seem to think that criminals come stamped with their crimes on their foreheads.

My main problem. The editorial overlooks the problems technology has created with regards to private weapons ownership. The simple fact is, in 1800 there was no gun in the world with which a lunatic could blow away a

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dozen plus people before being stopped. (As Harry Stine has noted, it is modern technology, in the form of cheap and rugged automatic weapons, which more than anything has led to the massive rise of terrorism.) And if that's not enough to make you reconsider, what about chemical, biological, and nuclear weapons? Does the Constitution affirm the right of individuals to keep and bear these beasties?

Again, this is not an academic matter. The whole point of the Second Amendment is that the people should be armed *at least as well* as their governments, if they are to keep their liberty. Nor can we, per Bretnor's own arguments, accomplish this by hoping to disarm governments: no, logic demands that the private citizen be allowed to personally own the ability to kill, not only dozens, but hundreds and even thousands of people whenever the urge hits him. Which it certainly will, to some of them, no matter what safeguards we put into place (indeed, the safeguards will probably involve a great expansion of police powers—consider that, o lovers of liberty!). This is a situation the Founding Fathers could not have foreseen; if they had, I seriously wonder if they would have phrased the Second Amendment the same way, or even still included it.

Alas, things get even worse. From where does the technology that has given us all this killware come? Government! (And big business, which, if it is big enough, is just as dangerous.) The average individual doesn't have the resources that R&D for modern perishphenalia involves. Thus, we must rely on government to provide us with the means to defend ourselves from government. Imagine: there are no independent book or magazine publishers, no private TV or radio stations or newspapers—you have to rely on the government to tell you what the government is up to. Makes you feel real secure, don't it?

Note that I'm not dissenting from Bretnor's conclusion: gun control and disarmament treaties just don't work. They won't solve the problems I've outlined above. But we can't just ignore them either. Which leaves what? At the moment, I won't claim to know. So I'll toss it out for your writers and readers. I know only that the "solutions" won't be easy.

DAVID J. STRUMFELS

A comment on the guest editorial in the March 1992 issue of *Analog*, "Words of Promise" by Reginald Bretnor.

Thank you for an enjoyable editorial. It was well thought out. Except for one section:

> ". . . I read of a felon, wounded in a shootout with the police, who was flown from Southern Oregon to Portland for medical treatment, again presumably at the taxpayers' expense.
>
> How crazy can we get?
>
> What would happen if anyone injured in the commission of a crime of violence, or of any crime involving the threat of a deadly weapon, knew in advance that the state would foot no bills for his treatment. Would that be a powerful deterrent?"

Perhaps it may, perhaps not. Either way, it's irrelevant: a criminal isn't a criminal until tried in a court of law. "Assumed innocent until proven guilty" is the phrase, I believe. If the State refuses to treat someone injured by the State on the grounds that they are a suspect, they are acting as if the suspect is already guilty.

Practically, it would save money. Maybe. What would be the cost in civil

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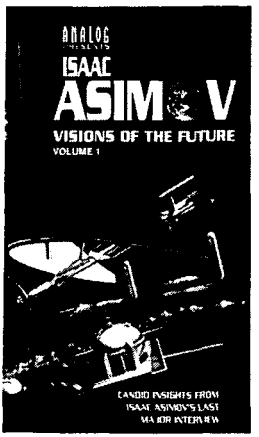

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suits should the State NOT 'foot the bill' and the suspect is found 'not guilty'? What would be the consequences, morally speaking?

STEWART J. STREMLER

San Diego, CA

The author replies. . . .

I'm happy to hear that you agree with the greater part of my guest editorial. With regard to the one point to which you took objection, you are of course entirely right legalistically. However, there are certainly contingencies in which a felon *cannot* be treated as a "suspect" presumed to be innocent and entitled to a formal trial: to wit, when in the actual commission of a violent crime it becomes necessary for either a law enforcement officer or a private citizen to use force against him as a defensive and preventive measure. It has always seemed strange to me that a bandit, say, can in the presence of any number of witnesses shoot and kill one or more people, police or civilians, then surrender or be captured and still, in the press and in the eyes of the law, be considered a "suspect." In such cases, while he should not be denied treatment if wounded, I still do not think the taxpayer should have to stand the expense. Thank you again for your letter.

REGINALD BRETNOR

Stan,

You certainly do invite argument with your editorials, but at least no one can say you don't give equal time to both sides . . . . Last month you were vehemently arguing against the government/society "letting" AIDS victims go around without notifying all those with whom they come in contact of their condition. Shades of the old leper bell . . .

This month you offer the podium to Mr. Bretnor who with equal vehemence argues against the government/society NOT "letting" all and sundry tote firearms around. So you're squarely on both sides of the "letting" issue.

Bretnor is a really strange case. I find his piece so offensive that it is hard to read through. (But then I can hardly stay tuned to the president's talks, either.) It is as if he has no regard for the actual issue but picks verbal weapons to bludgeon his reader into the state of mind he desires. And, while using your small portion of the ill-famed "media" to achieve his desires, denounces the media in general. One point in particular should be rebutted—his choice of Israel and Switzerland as societies that are "armed to the teeth" but with lower murder rates than ours. Both those countries REQUIRE their citizens to have and bear arms as part of the citizen militia/army etc. That's a little different case from ours. He might as well point to the sub-set of citizenry in our armed forces and ask what is the murder rate there, with arms universally available.

I'm getting tired of these demagogues who start out with some unarguable position—"crime is terrible!"—and then having achieved some agreement go on to offer fuel for anger, but no specific proposal that can be inspected and evaluated. Trouble is, it works. They keep getting elected.

WARREN RAYLE

Yes, the editorials exist largely to invite argument, hopefully stimulating thought *along the way. This means that they do, intentionally, explore a* range *of viewpoints instead of doggedly pushing* one.

I'm sorry you found Bretnor's tone offensive, but he did raise issues which you have not addressed. Should you decide to do so, on this or any other editorial, though, please be sure you're talking about the editorial that was actually printed. I did not even remotely, for ex-

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ample, suggest that AIDS victims should be required to notify "all those with whom they come in contact of their condition." I venture to hope that someday you'll take a close enough look to see what I really *said.*

Dear Dr. Schmidt,

Might a Canadian presume to comment on Bretnor's guest editorial in which he inveighed against disarmament, both international and interpersonal?

First, Canadians on the whole are, I believe, in favor of international disarmament. Indeed, some might feel that we have almost unilaterally disarmed ourselves. Oh, we played an important role in both big wars (getting into them much before you people did—I was commissioned in April of 1941). And we had a brigade group in Korea, and our air force and navy played a small part in the recent Gulf war.

But there are many now who would have us pull out of NORAD and NATO. I don't agree; but the sentiment is there. It is claimed that, without defense spending, we could improve our government-run health plans: one of the reasons why, now that I'm retired, I am glad I never took any of those high-salaried offers to go to the States. My wife and I have no fears that our bank account might be wiped out by illness or injury. Even drugs are free, for seniors. Indeed, the only medical expenses we have at present are for our dog and our two cats!

In interpersonal disarmament, we have fairly stiff gun control laws, which are supposed to get stiffer soon. Living as I have for years south of Detroit (yes, there are parts of the States north of Canada), and occasionally reading Detroit papers or watching Detroit TV, I have got to the point where I don't cross the border more than a couple of times a year. I feel safer at home—as I did when I lived in Toronto. And I knew that, unlike Detroit, my children were safe in school: some young punk wasn't going to take Daddy's (or Mommy's) pistol in to class and shoot up the room! That, I submit, is due largely to gun control: there are very few pistols lying around in the average household in Canada. And I note that most of the late night holdups of convenience stores are at knife—rather than gunpoint.

Myself, if I had the choice, I'd rather face a knife than a gun. Fifty years ago, my instructor in unarmed combat—"dirty fighting," they called it—showed us ways to handle the knife man. Against the gun—unless you had one out and fired first—your best defence was prayer!

I have often wondered about these rather fundamental differences between out two countries. Canada—at least English-speaking Canada—started out, not with a revolution, but with Loyalist immigration. My ancestors came to Canada in the 1780s from the Hudson and Mohawk valleys. And our first Constitution—which is now part of the new document signed by the queen in 1982—did not vest us with any inalienable rights: to life, to liberty, to the pursuit of happiness (or to keep and bear arms). Rather the putting together, the Confederation of Ontario, Quebec, and the maritimes was for the purpose of ensuring order and good government!

A. ARTHUR SMITH, PHD

Windsor, ONT

Attention Mr. Stanley Schmidt:

It is evening here as I write this. Today the news of the death of the good Doctor was flashed to the world. I am saddened by our loss. But, as he would have pointed out, it is the inevitable re-

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sult of being born.

I first met Isaac Asimov in the late forties. Introduction was by a man named John W. Campbell, Jr. Isaac Asimov was already a recognized light in the world of science fiction and I was a snot-nosed kid who thought he wanted to write for a living. Mr. Campbell encouraged me and took the time to read several terrible submissions to *Astounding*, and wrote critiques of them. I suppose he may have felt I had something he wanted to encourage. It didn't happen.

A fracas called the Korean Police Action interposed itself, and I was off to do my thing as a United States Marine. It was just a short time before this that I met the good Doctor. He wasn't called the good Doctor then. "Just call me Isaac." Of course he would never have remembered me. I was just another body in the editorial offices attempting to be something I was not. When I returned from the Hermit Kingdom I found that the urge for making money loomed larger then satisfying my writing itch. The itch has returned, if indeed it had ever left, so possibly some future submissions will go your way. But that is another matter.

There were several other times when I shook hands with the great man, (I will always think of him as "The Great Man,") but each time it was new to him. And why shouldn't it have been. I wrote nothing but letters and log books, while he wrote immortal fiction. However, I have never, and I will never forget him.

So the world turns and another great man reaches the end of his string. I know not what others will think or do in his memory. For myself, I will sit and remember the mighty books that sprang from his pen. The dynamic mind that took me away from this humdrum existence on a small backwater planet, and for a time carried me up, and out, and into the wonders of the Universe. I will remember his ready laugh on the times I was privileged to meet and talk to him, and the patience he exhibited with lesser mortals such as I.

I can't make the case that this world is poorer for his going, because it is not. What he left behind is a heritage of imagination that will endure for as long as men are able to read. What I can say is that I will miss reading the editorials he wrote for the magazine that bears his name. But we must consider that the editorials, as well as all his other writings are still here. Available for future generations to wonder at and laugh over. The world is not poorer that the journey of Mr. Good Doctor Isaac Asimov is completed. His books sit on the shelves of my home as they sit in other homes. A king's ransom of riches beyond counting. He will be there for me anytime I open a cover. Why then do I feel such loss?

LOUIS H. STURMER JR.

Fairfield, CA

To whom it may concern:

I am currently writing a book about science fiction and war. I would very much like any information on the World War II service of Robert Heinlein, who worked at the Philadelphia Naval Yard as a civilian engineer with OPNav-23 on anti-kamikaze defenses, among other things. I am also interested in the World War II service of other science fiction writers and editors recruited by Heinlein into the Navy Field Service, especially: Theodore Sturgeon, George O. Smith, John W. Campbell, Jr., Jay Stanton, Murray Leinster, L. Ron Hubbard, Sprague de Camp, and Fletcher Pratt. Thank you.

CHRIS HABLES GRAY, PH.D.,
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27-29 November
LOSCON 19 (Los Angeles area SF conference) at Los Angeles Airport Marriott, Los Angeles, Calif. Guest of Honor—Barbara Hambly; Editor Guest of Honor—David G. Hartwell; Fan Guest of Honor—Mike Glyer. Registration—$30 until 1 November, $35 at the door. Info: LASFS, Inc., 11513 Burbank Blvd., North Hollywood CA 91601. (213) 772-1511.

27-29 November
SILICON (California SF conference) at Santa Clara Westin Hotel, Santa Clara, Calif. Guest of Honor—Robert Jordan; Artist Guest of Honor—Richard Hescox; Fan Guest of Honor—Michelle Sagawa; TM—James P. Blaylock. Info: Silicon '92, Box 8029, San José CA 95155-8612. (408) 977-0562.

27-29 November
DARKOVER GRAND COUNCIL MEETING (Annual conference on Marion Zimmer Bradley's Darkover books) at Holiday Inn, Timonium, Md. Info: Armida Council, Box 7203, Silver Spring MD 20907. (202) 737-4609 (before 11:15 ET).

11-13 December
SMOFCON 9 (SF convention runners' conference) at Doubletree Hotel, New Orleans, La. Registration—$40 until 30 September. Info: William Jenkins, 8331 Donoghue St., New Carrollton MD 20784.

8-12 April 1993
SWANCON 18 (Australian National SF Convention) at Ascot Inn, Perth, W.A., Australia. Guest of Honour—Terry Pratchett; Fan Guest of Honour—Craig Hilton. Convention theme: Apocalypse. Registration: A$40 attending; A$20 supporting. Info: Swancon 18, Box 318, Nedlands, W. A. 6009 Australia.

2-6 September 1993
CONFRANCISCO (51st World Science Fiction Convention) at Parc 55, ANA Hotels, Moskone Centre, San Francisco, Calif. Guest of Honor—Larry Niven; Artist Guest of Honor—Alicia Austin; Fan Guests of Honor—Tom Digby and jan howard finder; MC—Guy Gavriel Kay. Registration—$85 adult/$30 child until 30 September 1992. Supporting— $25. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: 712 Bancroft Rd, #1993, Walnut Creek CA 94598. (510) 945-1993. CompuServe 72377,3623.

You can send me e-mail about your convention—A.LEWIS20 on the GEnie℠ network.

—Anthony Lewis

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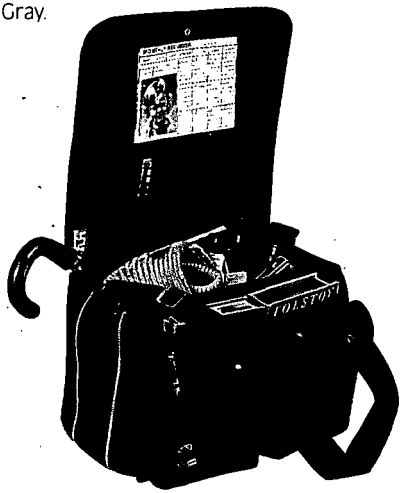

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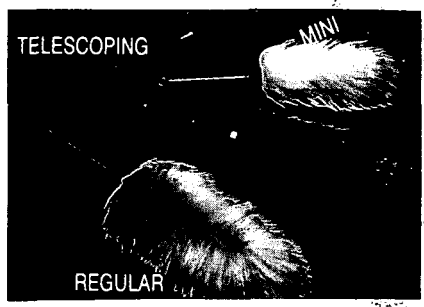

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